GeoSmart Information

SuDSmart Plus

Sustainable Drainage Assessment

Site Address

11 Yeading Lane
Hayes
UB4 OEL

Grid Reference

510633, 181165

Report Prepared for

Juttla Architects,
Argyle House,
Joel Street,
Northwood Hills,
Middlesex,
HA6 1NW.

Date

2024-09-10

Report Status

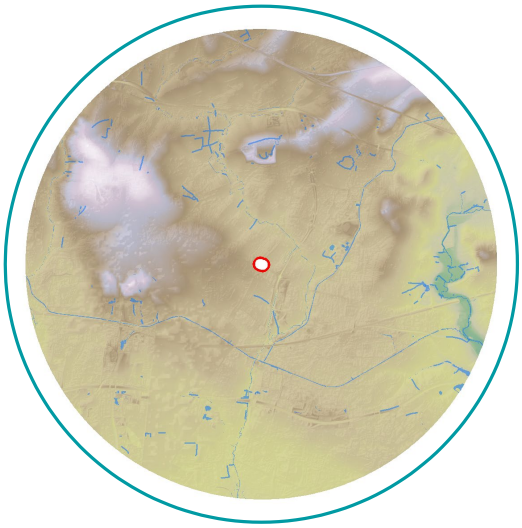
FINAL

Site Area

0.095 ha

Report Reference

83133R1



Discharge to surface water sewer

The proposed Sustainable Drainage Scheme (SuDS) strategy is comprised of a green roof, rain gardens, permeable paving and an attenuation tank to attenuate surface water runoff during the 1 in 100 plus 40% climate change event.

Surface water will continue to discharge via a connection to the public surface water sewer network, subject to confirmation from the sewer utility provider, and the incorporation of SuDS.

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1 Executive summary

This report assesses the feasibility of a range of Sustainable Drainage Scheme (SuDS) options in support of the Site development process. A SuDS strategy is proposed to ensure surface water runoff can be managed effectively over the lifetime of the development.

SuDS suitability

Risk	Issue	Result
Discharge Location	What is the infiltration potential at the Site?	Low
	What is the potential to discharge to surface water features?	Low
	What is the potential to discharge to sewers?	High
	What is the potential to discharge to highway drains?	High
Flooding	What is the river (fluvial) flood risk at the Site?	Very Low
	What is the surface water (pluvial) flood risk at the Site?	Very Low to Low
	What is the groundwater flood risk at the Site?	Negligible
Pollution	Is the groundwater a protected resource?	No
	Is the surface water feature a protected resource?	N/A

Summary of existing and proposed development

The Site is currently used within a residential capacity. At present there is a single building with a driveway and landscaped areas. Development proposals comprise the demolition of the existing residential dwelling and the construction of two new residential buildings with 9 individual residential apartments plus a new bike store and bin store.

Summary of discharge routes

GeoSmart's SuDS Infiltration Potential (SD50) map indicates the Site has a Low potential for infiltration, primarily due to the low permeability of the underlying geology (Langley Silt overlying London Clay). Infiltration to ground is therefore unlikely to be feasible.

Ordnance Survey (OS) mapping indicates that there are no surface water features within 100 m of the Site. Therefore, discharge to surface water feature is not feasible.

The asset location plan search included in Appendix C confirms the Site is located within c. 105 m of the public sewer network. Due to the short distance to nearby sewers discharging surface water runoff to the sewer is feasible.

Runoff rate and attenuation requirements

Discharging off-Site requires 39.79 m^3 of attenuation to be provided to ensure there is no flooding within the development in all storm events up to and including the 1 in 100 year including a 40% allowance for climate change. This volume is subject to the discharge rate being restricted to 1 l/s (as close to the equivalent Greenfield 1 in 100 year rate as possible, without increasing the potential for blockages).

Proposed SuDS strategy

SuDS features comprised of green roofs, rain gardens, rainwater harvesting, permeable paving and an attenuation tank are proposed to attenuate a minimum of 43.31 m^3 of surface water runoff.

The proposed SuDS strategy would ensure surface water runoff is stored on-Site in SuDS features for the 1 in 100 year event including a 40% allowance for climate change and will not cause flooding to the proposed development in accordance with DEFRAs non-statutory technical standards (DEFRA, 2015).

SuDS & drainage network maintenance

The management and maintenance of the SuDS features, in line with the details and schedules outlined in Section 10 of this report, will be undertaken by contractors appointed by the owners and occupiers of the new residential building.

Recommendations / Next steps

The capacity of the public sewer network should be confirmed with the utility provider and permission to connect gained where required.

2 Proposed SuDS strategy

The most suitable SuDS options are outlined below and a SuDS strategy schematic is shown overleaf. Supporting information is provided in subsequent sections.

Table 1. Proposed SuDS type, features, discharge location and rate restriction

SuDS type	Source control (interception) and attenuation SuDS.
SuDS features	Permeable paving, rainwater harvesting, green roof, attenuation tank.
Discharge location	Surface water sewer network.
Discharge rate	1 l/s (where discharge to sewer/surface water feature is proposed).

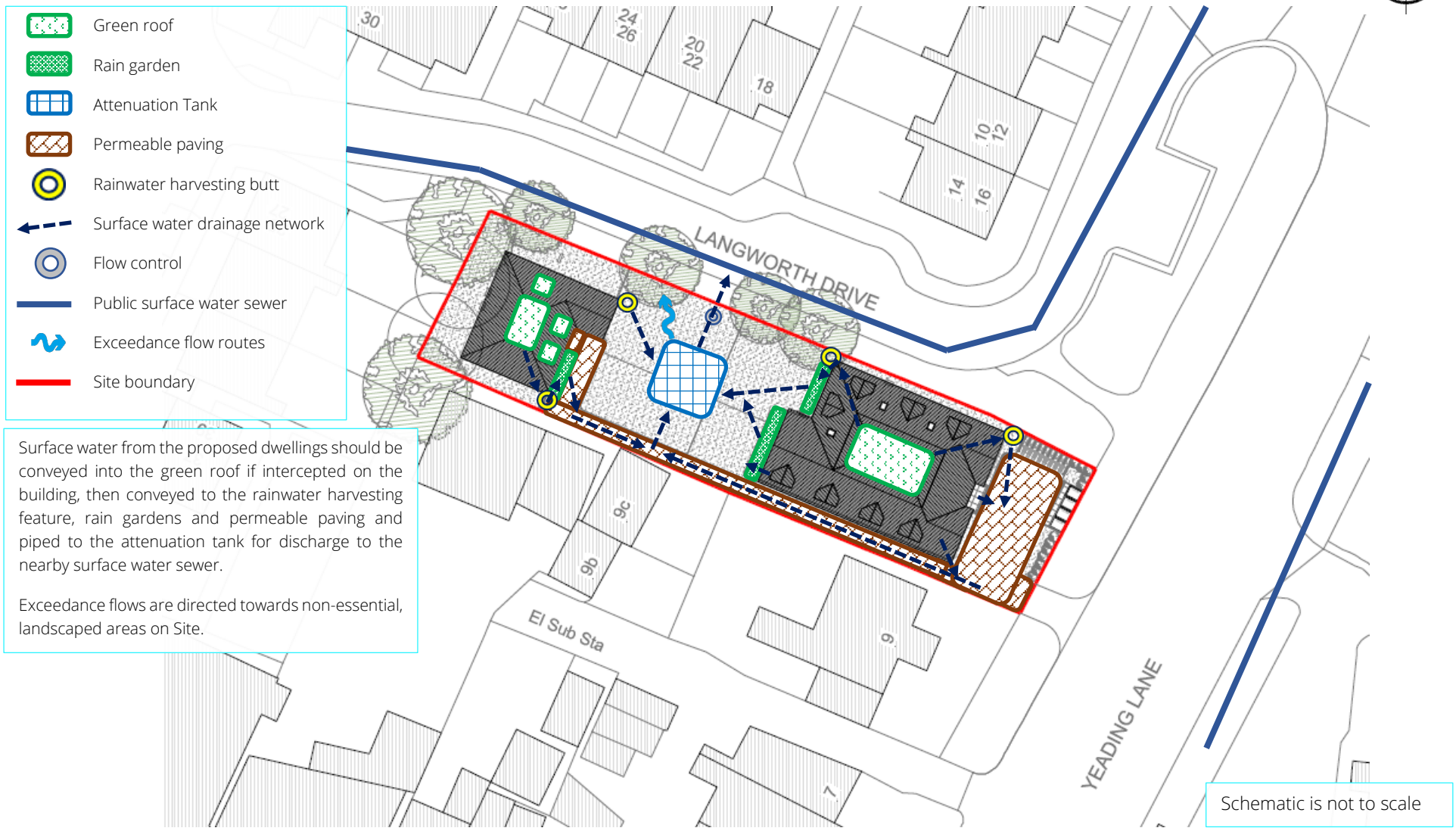
Table 2. Proposed SuDS sizing (dimensions) and attenuation volumes

Rainwater Harvesting	To comply with London Plan policy, a rainwater harvesting butt(s) should be established for the / each proposed development. In terms of attenuation storage within this SuDS scheme, the volume of run-off which could be attenuated by Rainwater Harvesting has not been considered within the Preliminary SuDS schematic.
Green Roof	A green roof covering a total area of 52 m^2 (cover area of all roof spaces) is proposed. This will provide amenity, biodiversity and water quality benefits while also helping slow down flows. This would result in 1.69 m^3 attenuation.
Rain Garden	20 m^2 of rain gardens with a 0.4 m depth of soil and 0.2 m depth of porous (35% porosity) aggregate, including 0.1 m of storage above the topsoil would provide c. 3.20 m^3 attenuation.
Permeable Paving	A 163 m^2 area of permeable paving (underlain with a Type 3 aggregate material) within the proposed driveway areas to a depth of 0.3 m, with a 30% porosity would result in 14.67 m^3 attenuation.
Attenuation Tank	An attenuation tank with a length of 5 m, width of 5 m and depth of 1 m under the lawn in the garden of the Site would result in 23.75 m^3 attenuation.
Total Attenuation Provided	41.62 m^3
Total Attenuation Required	39.79 m^3

Freeboard Storage Provided	1.83 m³

GeoSmart Information

Figure 1. Proposed SuDS scheme



Surface water from the proposed dwellings should be conveyed into the green roof if intercepted on the building, then conveyed to the rainwater harvesting feature, rain gardens and permeable paving and piped to the attenuation tank for discharge to the nearby surface water sewer.

Exceedance flows are directed towards non-essential, landscaped areas on Site.

Schematic is not to scale

3 Site analysis

Site location

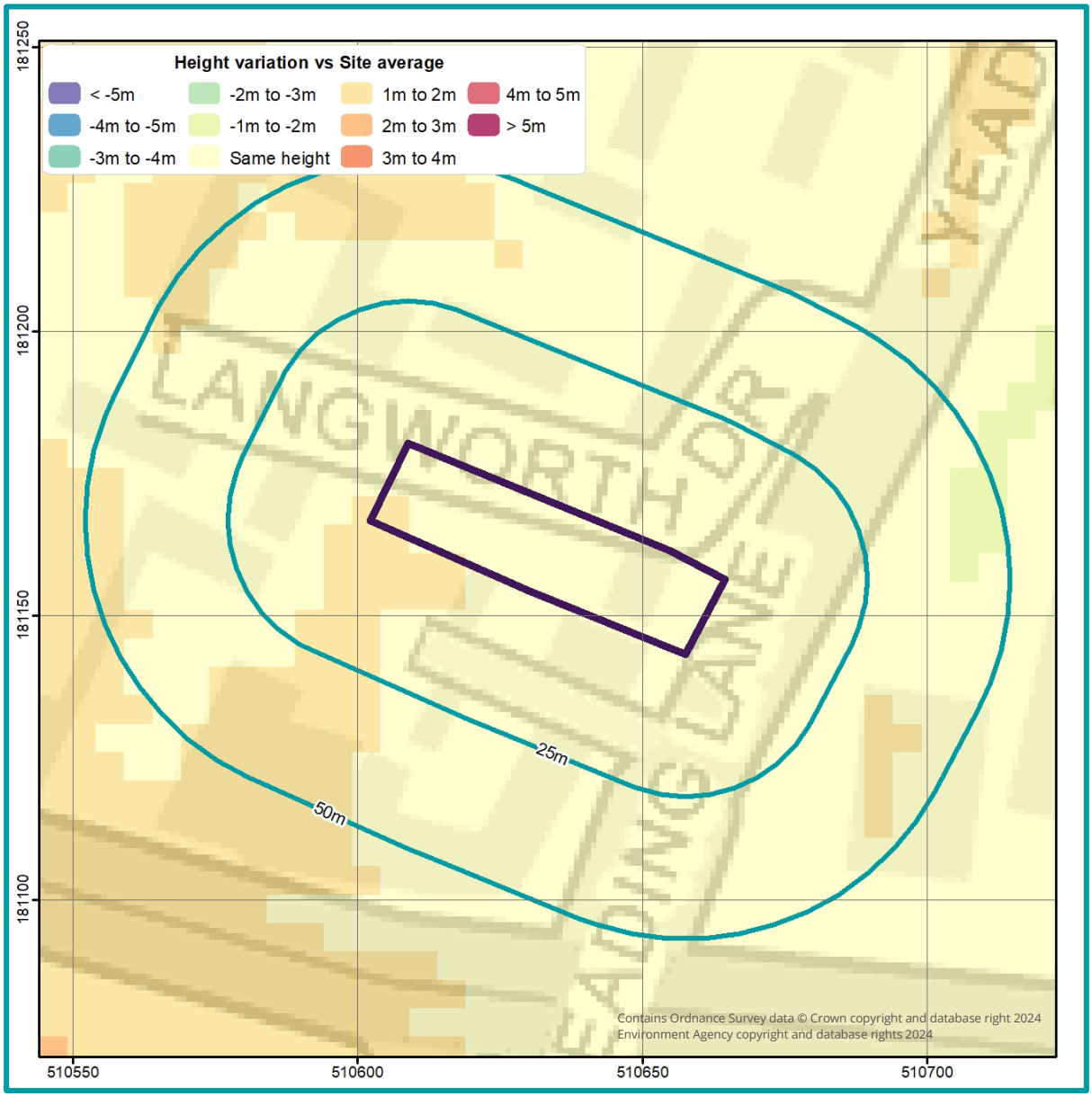
Figure 1. Aerial Imagery (Bluesky, 2024)

Figure 2. SuDS infiltration suitability (SD50) map (GeoSmart, 2024)

The GeoSmart SuDS Infiltration Suitability Map (SD50) screens the potential for infiltration drainage at the Site and indicates where further assessment is recommended. The map combines information on the thickness and permeability of the underlying material and the depth to the high groundwater table. It supports conceptual Site drainage design and the planning of further Site investigation.

There is a Low potential for infiltration SuDS across the Site. It is likely that the underlying geology at the Site has low permeability which would limit the effectiveness of a proposed infiltration SuDS scheme.

Figure 3. Site topography (GeoSmart, 2024)



An assessment of the topography at the Site has been undertaken using LiDAR DTM5 elevation data to identify the general slope and any localised depressions. The mapping shows a comparison between average ground levels on the Site with ground levels in the surrounding area. The mapping confirms the overall Site is gently falls to the southeast..

Further analysis could be undertaken by visiting the Site or by collecting additional topographic survey to provide further confirmation of ground levels.

Figure 4. Source protection zone map (EA, 2024)

An assessment of the EA's groundwater Source Protection Zones (SPZs) has been undertaken within the vicinity of the Site and confirms the Site is not located within an SPZ.

Infiltration, if possible, is likely to be acceptable providing risk screening identifies suitable mitigation measures, if required, to prevent an impact on water quality from the proposed or historical land use and contaminated land.

If further analysis is required, this would involve a review of Site specific contaminated land data. If hazards are identified, it is recommended that the Local Authority and the Environment Agency are contacted to confirm the susceptibility of any SPZs within the wider area.

Figure 5. Surface water features map (EA, 2024)

Ordnance Survey (OS) mapping indicates that there are no surface water features within 100 m of the Site. Therefore, discharge to surface water feature is not feasible.

Further analysis could be undertaken by visiting the Site or by contacting the Local Council and the Environment Agency (EA) to confirm the presence, location and condition of any mapped or additional unmapped surface water features.

Figure 6. Sewer features map (OS & Thames Water, 2024)

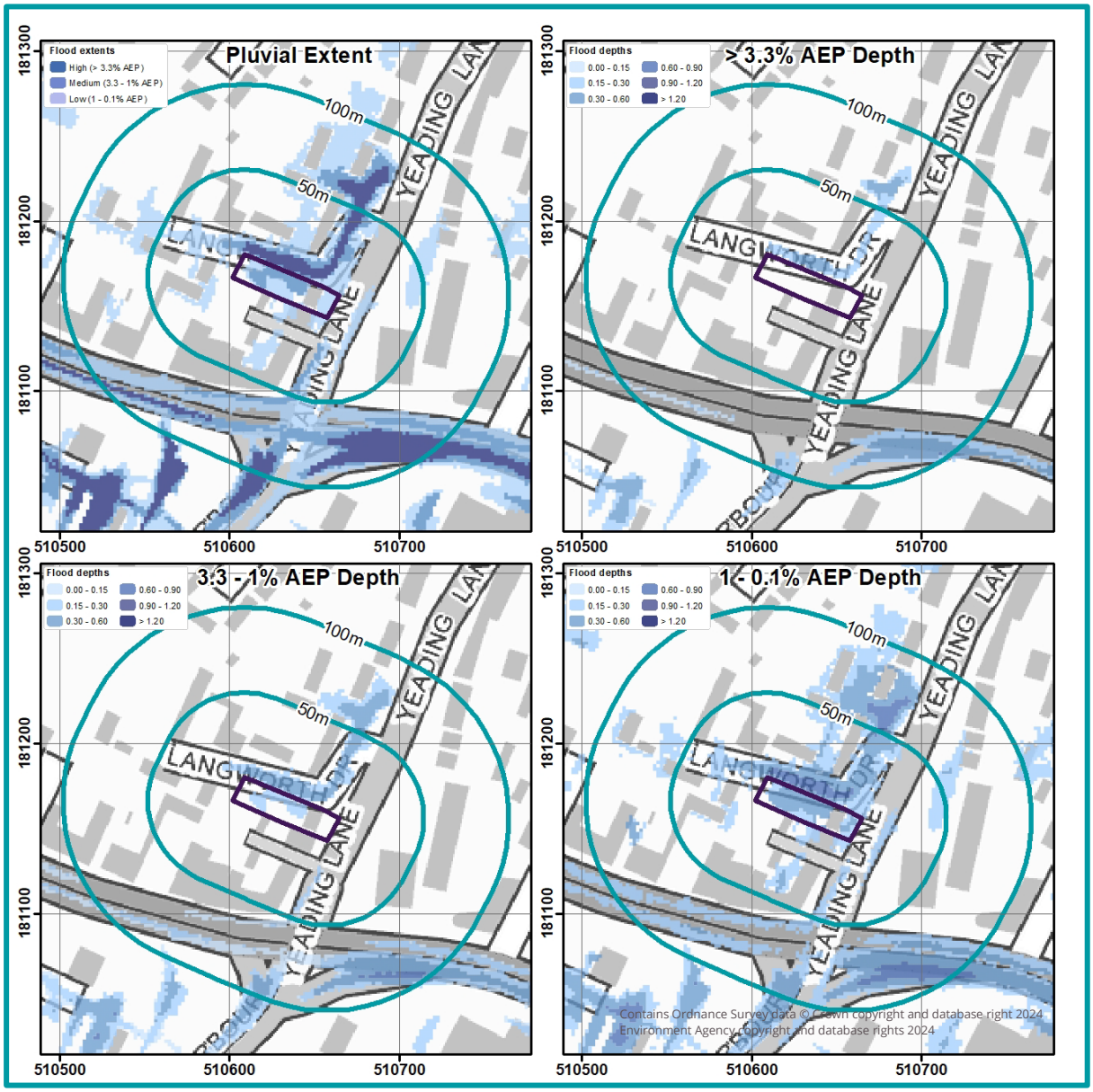
GeoSmart has undertaken an assessment of the location of sewer features within the vicinity of the Site. There is a public surface water sewer, located adjacent to the north of the Site, therefore discharge to sewer is likely to be appropriate.

Further analysis of the connections and condition of the public surface water drainage system should be undertaken by carrying out a CCTV survey or by contacting the drainage provider or the Local Council to confirm the presence, location and condition of the sewer. Consultation with the drainage provider would also be required to determine that sufficient capacity is available to accept the proposed discharge, and to gain permission to connect if required.

Figure 7. Risk of flooding from rivers & sea map (EA, 2024)

According to the EA's Risk of Flooding from Rivers and the Sea (RoFRS) map, the Site has a Very Low risk of flooding from fluvial or coastal flooding, with less than 0.1% annual probability of flooding, therefore the SuDs design is unlikely to be affected.

Figure 8. Risk of surface water flooding map (EA,2024)



GeoSmart have undertaken an assessment of the risk of flooding from surface water (pluvial) sources within the vicinity of the Site using the EA's Risk of Flooding from Surface Water (RoFSW) mapping. The EA's mapping confirms the Site is considered to be at Medium risk of surface water flooding.

The above map shows the extent and depth of flooding during the >3.3% annual probability (AEP) (1 in 30 year – High risk), 3.3 – 1% AEP (1 in 100 year – Medium risk) and 1 – 0.1% AEP (1 in 1000 year – Low risk) events. This confirms there are areas where flooding could occur in a 1 in 100 and 1 in 1000 year events. Flooding in these areas may constrain certain types of SuDS features being used.

Further analysis could be undertaken by visiting the Site or by contacting the Local Council and the Environment Agency to confirm the pluvial flood risk, flood depths and velocities where applicable.

Figure 9. Groundwater flood risk (GW5) map (GeoSmart, 2024)

GeoSmart have undertaken an assessment of the risk of flooding from groundwater within the vicinity of the Site. GeoSmart's Groundwater Flood Risk Screening (GW5) map confirms the Site has a Negligible risk of groundwater flooding during a 1% annual probability (1 in 100 year) event.

4 Site context

Site information

The purpose of this report is to assess the potential for disposing of surface water through a Sustainable Drainage System (SuDS) for the site of 11 Yeading Lane, Hayes, UB4 0EL (the Site). The Site is located in a setting of commercial and residential use. The land slopes to the southeast from 31.81 mAOD to 32.38 mAOD. This is based on EA elevation data obtained for the Site to a 1 m resolution with a vertical accuracy of ±150 mm. Site plans and drawings are provided in Appendix A.

Development

The Site is currently used within a residential capacity. At present there is a single building with a car park and landscaped areas. Development proposals comprise the demolition of the current residential dwelling and the construction of two new buildings for 9 individual residential flats while keeping the existing landscaping and access features already located on the Site.

Geology, permeability and thickness

British Geological Survey (BGS) national superficial and bedrock geology mapping confirms the geological formations underlying the Site and each formation may have a range of permeability.

Table 3. Site Geology

Geology present on-Site		Potentially permeable?
Superficial geology (Figure 11)	Langley Silt Member (LASI) – clay and silt	X
Bedrock geology (Figure 12)	London Clay Formation (LC) – clay, silt and sand	X

The permeability of the underlying material at the Site shown within the BGS mapping is low, confirmation of the infiltration capacity is not considered to be required.

The BGS website was used to extract ground information from the nearest borehole records to the Site (ref: TQ18SW56 and TQ18SW284). These boreholes are located approximately 120 m to the southwest and 120 m to the southeast of the Site at an elevation of 33.91 and 31.84 mAOD respectively.

The borehole record (TQ18SW56) confirms the underlying geology is comprised of Made Ground to a depth of between 0 m bgl and 2.44 m below ground level (bgl) underlain by River Terrace deposits to a depth of between 2.44 m to 3.51 m (bgl) underlain by London Clay to a depth 13.72 m bgl where the longest borehole was terminated.

The borehole record (TQ18SW284) confirms the underlying geology is comprised of Made Ground to a depth of between 0 m bgl and 1.00 m below ground level (bgl) underlain by River Terrace deposits to a depth of between 1.00 m to 4.70 m (bgl) underlain by London Clay to a depth 15 m bgl where the longest borehole was terminated.

Depth to groundwater

The SuDS system should be designed to operate in periods of extreme groundwater levels.

Relevant boreholes indicate groundwater levels were at 4.40 m bgl, rising to 4.30 m bgl after 20 minutes (TQ18SW284), on 07/04/2003.

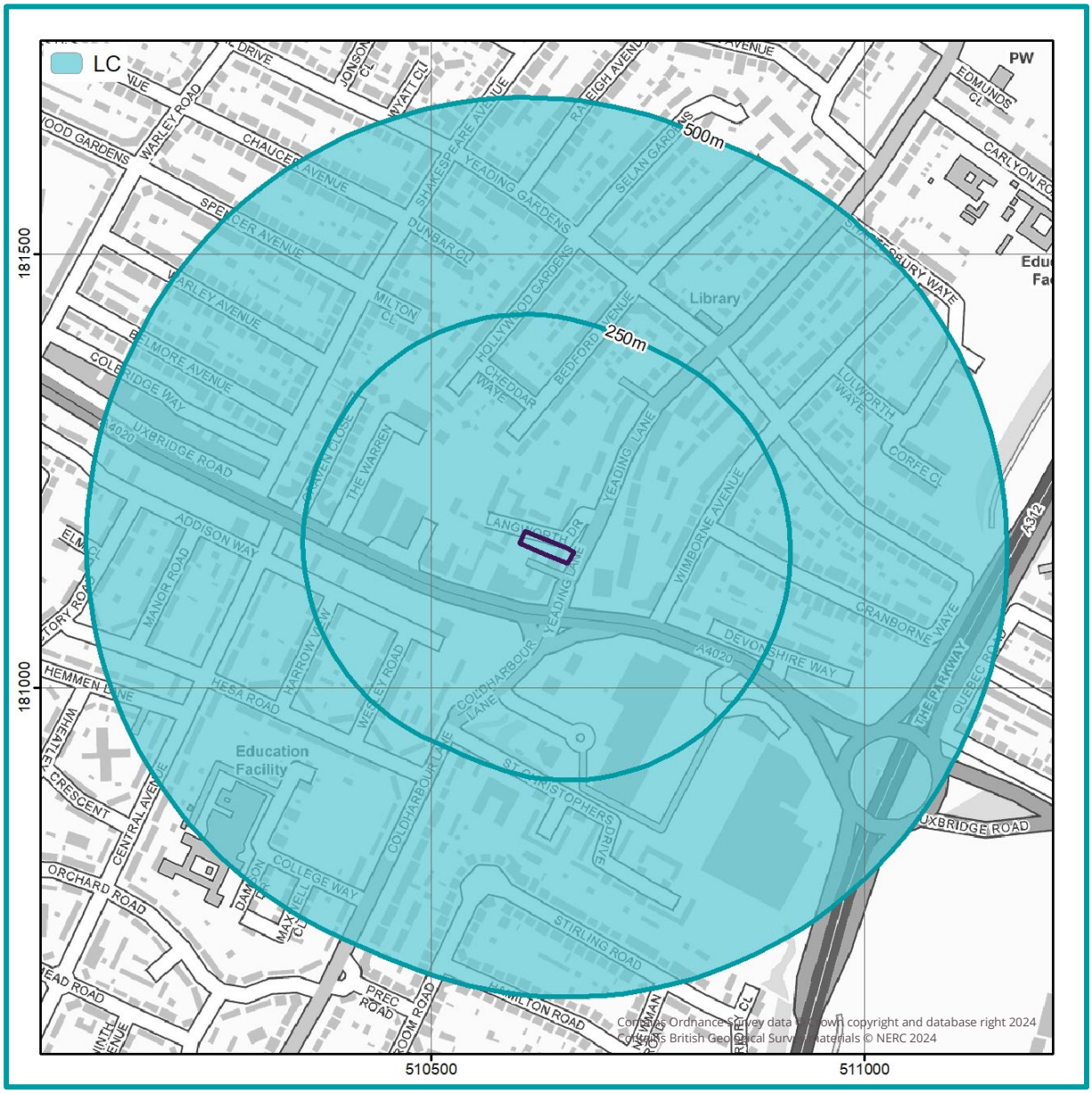
Borehole TQ18SW284 records indicate that groundwater levels were at 4.40 m bgl, rising to 4.30 m bgl after 20 minutes, on 07/04/2003. Borehole TQ18SW56 did not strike groundwater at any depth of the borehole.

According to borehole data and GeoSmart's Groundwater Flood Risk (GW5) map, shallow groundwater is unlikely to be an issue at the Site.

Infiltration features are not proposed at the Site, given the low permeability of the underlying geology.

Figure 10. Superficial Geology (BGS, 2024)

Figure 11. Bedrock Geology (BGS, 2024)



Ground conditions

Infiltration SuDS features are not proposed at the Site, therefore a detailed investigation into the ground conditions is not required.

Water quality

The Site does not lie within an SPZ and infiltration is not proposed. Further consultation with the water company is unlikely to be required.

5 National & local policy context

National Guidance

CIRIA SuDS Manual (C753) (2015)

A development should utilise sustainable drainage systems (SUDS) unless there are practical reasons for not doing so, and should aim to achieve greenfield run-off rates and ensure that surface water run-off is managed as close to its source as possible in line with the following drainage hierarchy:

1. Use infiltration techniques, such as porous surfaces in non-clay areas,
2. attenuate rainwater in ponds or open water features for gradual release,
3. attenuate rainwater by storing in tanks or sealed water features for gradual release,
4. discharge rainwater direct to a watercourse,
5. discharge rainwater to a surface water sewer / drain,
6. discharge rainwater to the combined sewer.

Defra - Sustainable Drainage Systems: Non-statutory technical standards for sustainable drainage systems (2015)

Peak Flow control

For developments which were previously developed, the peak runoff rate from the development to any drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event must be as close as reasonably practicable to the greenfield runoff rate from the development for the same rainfall event, but should never exceed the rate of discharge from the development prior to redevelopment for that event.

For greenfield developments, the peak runoff rate from the development to any highway drain, sewer or surface water body for the 1 in 1 year rainfall event and the 1 in 100 year rainfall event should never exceed the peak greenfield runoff rate for the same event.

Volume control

Where reasonably practicable, for developments which have been previously developed, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event must be constrained to a value as close as is reasonably practicable to the greenfield runoff volume for the same event, but should never exceed the runoff volume from the development site prior to redevelopment for that event. The runoff volume must be discharged at a rate that does not adversely affect flood risk.

The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur on any part of the Site for a 1 in 30 year rainfall event.

Ministry of Housing, Communities & Local Government – National Planning Practice Guidance: Flood risk assessments: climate change allowances (2022)

The Peak rainfall intensity allowances section provides advice on the increased rainfall effects on river levels and land and urban drainage systems. As of May 2022, the applicable climate change allowance is defined by specific Management Catchment for the 1 in 30 (≥ 3.3% AEP) and 1 in 100 (< 3.3 to 1% AEP) year event.

As the Site is located within the London Management Catchment the following climate change allowances are applicable.

Table 4. London Management Catchment peak rainfall allowances

London Management Catchment	3.3% Annual exceedance rainfall event		1% Annual exceedance rainfall event	
	2050s	2070s	2050s	2070s
Central	20%	20%	20%	25%
Upper end	35%	35%	40%	40%

The drainage system should be designed to make sure there is no increase in the rate of runoff discharged from the Site for the upper end allowance.

Where on-Site flooding for the upper end allowance presents a significant flood hazard (for example, depths and velocities of surface water runoff cause a significant danger to people), you will need to take further mitigation measures to protect people and property (for example, raising finished floor levels). As a minimum, there should be no significant flood hazard to people from on-Site flooding for the central allowance.

Sub-national Drainage Policy

London Plan - Policy SI13 Sustainable drainage (2021)

Lead Local Flood Authorities should identify – through their Local Flood Risk Management Strategies and Surface Water Management Plans – areas where there are particular surface water management issues and aim to reduce these risks. Increases in surface water run-off outside these areas also need to be identified and addressed. Development proposals should aim to achieve greenfield run-off rates and ensure that surface water run-off is managed as close to its source as possible. There should also be a preference for green over grey features, in line with the following drainage hierarchy:

1. Rainwater use as a resource (for example rainwater harvesting, blue roofs for irrigation);
2. Rainwater infiltration to ground at or close to source;

3. Rainwater attenuation in green infrastructure features for gradual release (for example green roofs, rain gardens);
4. Rainwater discharge direct to a watercourse (unless not appropriate);
5. Controlled rainwater discharge to a surface water sewer or drain;
6. Controlled rainwater discharge to a combined sewer.

Development proposals for impermeable surfacing should normally be resisted unless they can be shown to be unavoidable, including on small surfaces such as front gardens and driveways.

Drainage should be designed and implemented in ways that promote multiple benefits including increased water use efficiency, improved water quality, and enhanced biodiversity, urban greening, amenity and recreation.

Development proposals should aim to get as close to greenfield run-off rates as possible depending on Site conditions. The well-established drainage hierarchy set out in this policy helps to reduce the rate and volume of surface water run-off. Rainwater should be managed as close to the top of the hierarchy as possible. There should be a preference for green over grey features, and drainage by gravity over pumped systems. A blue roof is an attenuation tank at roof or podium level; the combination of a blue and green roof is particularly beneficial, as the attenuated water is used to irrigate the green roof.

For many sites, it may be appropriate to use more than one form of drainage, for example a proportion of rainwater can be managed by more sustainable methods, with residual rainwater managed lower down the hierarchy. In some cases, direct discharge into the watercourse is an appropriate approach, for example rainwater discharge into the tidal Thames or a dock. This should include suitable pollution prevention filtering measures, ideally by using soft engineering or green infrastructure. In addition, if direct discharge is to a watercourse where the outfall is likely to be affected by tide-locking, suitable storage should be designed into the system. However, in other cases direct discharge will not be appropriate, for example discharge into a small stream at the headwaters of a catchment, which may cause flooding. This will need to be assessed on a case-by-case basis, taking into account the location, scale and quality of the discharge and the receiving watercourse. The maintenance of identified drainage measures should also be considered in development proposals.

Local Policy

London Borough of Hillingdon Local Plan Part 2 Development Management Policies (January 2020)

Policy DMEI 10: Water Management, Efficiency, and Quality

A) Applications for all new build developments (not conversions, change of use, or refurbishment) are required to include a drainage assessment demonstrating that appropriate sustainable drainage systems (SuDS) have been incorporated in accordance with the London Plan Hierarchy (Policy 5.13: Sustainable drainage).

B) All major new build developments, as well as minor developments in Critical Drainage Areas or an area identified at risk from surface water flooding must be designed to reduce surface water run-off rates to no higher than the pre-development greenfield run-off rate in a 1:100 year storm scenario, plus an appropriate allowance for climate change for the worst storm duration. The assessment is required regardless of the changes in impermeable areas and the fact that a site has an existing high run-off rate will not constitute justification.

C) Rain Gardens and non householder development should be designed to reduce surface water run-off rates to Greenfield run-off rates.

D) Schemes for the use of SuDS must be accompanied by adequate arrangements for the management and maintenance of the measures used, with appropriate contributions made to the Council where necessary.

E) Proposals that would fail to make adequate provision for the control and reduction of surface water run-off rates will be refused.

F) Developments should be drained by a SuDS system and must include appropriate methods to avoid pollution of the water environment. Preference should be given to utilising the drainage options in the SuDS hierarchy which remove the key pollutants that hinder improving water quality in Hillingdon. Major development should adopt a 'treatment train' approach where water flows through different SuDS to ensure resilience in the system.

6 Storage, volume and peak flow rate

Suggested minimum and aspirational storage requirements for an attenuation SuDS scheme for the development footprint are set out below, with more detail provided in subsequent sections. Storage volumes may be reduced (but not below the minimum level) if the design incorporates off-Site discharge.

Table 5. Storage requirements at the proposed development Site (Discharge runoff to surface water sewer)

Attenuation scenario		Attenuation required (m^3)	Explanation	
Discharge runoff to surface water sewer	1 in 30 year	17.80	Attenuation required to ensure surface water runoff is attenuated in all storm events up to and including the 1 in 30 year (2 hour, Critical Storm Duration) event*. Flooding of the Site of 7.53 m^3 should be contained within permeable landscaped areas within the Site to ensure no flooding of internal areas during the 1 in 100 year storm event.	A further 14.45 m^3 should be managed within overland flow routes to ensure there is no increase in flood risk in all events up to the 1 in 100 year including 40% allowance for climate change.
	1 in 100 year	25.33	Attenuation required to ensure surface water runoff is attenuated in all storm events up to and including the 1 in 100 year (3 hour, Critical Storm Duration) event*.	
	1 in 100 year including 40% CC	39.79	Attenuation required to ensure surface water runoff is attenuated in all storm events up to and including the 1 in 100 year (3 hour, Critical Storm Duration) event including a 40% allowance for climate change*.	

*See Appendix B for associated runoff and discharge calculations. Discharge rates all restricted as close as possible to greenfield rates in their respective events.

Surface water runoff

An increase in impermeable area on-Site will result in greater rainfall runoff. Reduction in runoff will help mitigate flood risk both on and off-Site. Further information on the surface water runoff calculations is provided in Section 12 'Background Information'.

Guidance

The Non-Statutory Technical Guidance for SuDS (Defra, March 2015) states:

"Where reasonably practicable, for Greenfield development, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event should never exceed the Greenfield runoff volume for the same event. Where reasonably practicable, for developments which have been previously developed, the runoff volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event must be constrained to a value as close as is reasonably practicable to the Greenfield runoff volume for the same event, but should never exceed the runoff volume from the development site prior to redevelopment for that event."

Table 6. Change in impermeable area associated with the development

Total Site area	945 m^2
Impermeable area (and as a percentage of the total area of the proposed development footprint of 945 m^2)	
Pre-development	Post-development
265 m^2 (28%)	575 m^2 (61%)
Impermeable land use: Commercial office, car park Permeable land use: landscaped areas	New impermeable land use: 240 m^2 front residential building 105 m^2 rear residential building 160 m^2 driveway and rear access path 8 m^2 bin store 10 m^2 bike store Plus 10% urban creep New permeable land use: Landscaped areas

*Please note, while these areas will be utilized for SuDS, for the calculations these areas will be classed as impermeable in order to assess the potential run-off volumes and rates for the Site post- development and the potential holding capability of the proposed SuDS features.

Guidance

"The drainage system must be designed so that, unless an area is designated to hold and/or convey water as part of the design, flooding does not occur on any part of the site for a 1 in 30 year rainfall event' and 'flooding does not occur during a 1 in 100 year rainfall event in any part

of: a building (including a basement); or in any utility plant susceptible to water (e.g. pumping station or electricity substation) within the development"

(Defra, March 2015, non-statutory guidance).

Peak discharge rates

The table below presents peak discharge rates for a range of storm events used to assess the impact of the proposed development and select the maximum permitted discharge rate. Further information on the calculation and control of peak discharge rates is provided in Section 12 'Background Information'.

Table 7. Peak discharge rates associated with the development

Rainfall event	Greenfield runoff rates (l/s)	Existing runoff rates[1] (l/s)	Potential runoff rates without attenuation (l/s)	Potential minus existing (l/s)
QBAR	0.40	N/A	N/A	N/A
6 hour 1 in 1 year	0.34	0.74	0.86	0.12
6 hour 1 in 10 year	0.64	1.27	1.47	0.20
6 hour 1 in 30 year	0.89	1.66	1.93	0.27
6 hour 1 in 100 year	1.27	2.17	2.52	0.35
6 hour 1 in 100 year + 20% CC	N/A	N/A	3.02	0.85
6 hour 1 in 100 year + 40% CC	N/A	N/A	3.53	1.36

[1] Assumes 100% runoff from impermeable surfaces. Assumes Greenfield runoff from permeable surfaces calculated using the IoH124 method.

Relevant national, regional and local planning policy has been consulted in Section 5 to determine restrictions on runoff from previously developed and greenfield sites. In some cases, greenfield rates may be requested, but in practice it is difficult to restrict discharge rates at any one control point to less than 1 l/s, without increasing the risk of any potential blockages occurring in the drainage network.

Total discharge volumes

The table below presents discharge volumes for a range of storm events used to assess the impact of the proposed development and calculate the required storage volumes. Further

information on the calculation of total discharge volumes is provided in Section 11 'Methodology and Limitations'.

Table 8. Total discharge volumes associated with the development

Rainfall event	Greenfield runoff volume (m^3)	Existing runoff volume[2] (m^3)	Potential runoff volume without attenuation (m^3)	Potential minus existing (m^3)
QBAR	11.80	N/A	N/A	N/A
6 hour 1 in 1 year	10.97	15.94	18.51	2.57
6 hour 1 in 10 year	19.21	27.50	31.78	4.28
6 hour 1 in 30 year	24.73	35.94	41.74	5.80
6 hour 1 in 100 year	32.24	46.85	54.41	7.55
6 hour 1 in 100 year + 20% CC	N/A	N/A	65.29	18.44
6 hour 1 in 100 year + 40% CC	N/A	N/A	76.17	29.32

[2] Assumes 100% runoff from impermeable surfaces. Assumes Greenfield runoff from permeable surfaces calculated using the IoH124 method.

Critical storm duration and volume requirements

Storage volumes for a range of return periods including the 1 in 30 year, 1 in 100 year and 1 in 100 year plus climate change (40%) events have been calculated to assess the impact of the proposed development. The required storage volumes for attenuation features have been calculated for the critical storm durations, limited to a maximum discharge rate of 1 l/s.

Table 9. Critical Storm Duration and Attenuation volume requirements

Return Period	Runoff rate restriction (l/s)	Critical Storm Duration (hr)	Attenuation volume required (m^3)
1 in 30 year	1.00	2.00	17.80
1 in 100 year	1.00	3.00	25.33
1 in 100 year including a 40% climate change	1.00	3.00	39.79

7 Runoff destination

Options for the destination for the runoff generated on-Site have been assessed in line with the prioritisation set out in the Building Regulations Part H document (HM Government, published in 2010 and updated in 2015) and Defra's Non-statutory Technical Standards for SuDS (2015).

Flow attenuation using infiltration SuDS (discharge to ground) is generally the preferred option. If discharge to ground is not available, runoff discharge to surface water is the other preferred method. Only if these two options are impractical should discharge to the sewer network be considered.

Discharge to ground

The Site has low potential for infiltration, with low permeability underlying London clay. Therefore, infiltration to ground is not considered to be feasible.

Discharge to surface watercourse

Ordnance Survey (OS) mapping indicates that there are no surface water features within 100 m of the Site. Therefore, discharge to surface water feature is not feasible.

Discharge to sewer

GeoSmart has undertaken an assessment of the location of sewer features within the vicinity of the Site. There is a public surface water sewer, located adjacent to the north and east of the Site, therefore discharge to sewer is likely to be appropriate.

If required consultation with the local sewer undertaker should be undertaken. Discharge to sewer would only be accepted if it can be demonstrated that none of the above options are reasonably practical. Discharge would have to be controlled, and on-Site attenuation would be required.

The topographic gradient on the Site falls towards the existing drainage network along the main road. It is likely that runoff would drain by gravity.

8 Water quality

A key requirement of any SuDS system is that it protects the receiving water body from the risk of pollution. This can be effectively managed by an appropriate "train" or sequence of SuDS components that are connected in series. The frequent and short duration rainfall events are those that are most loaded with potential contaminants (silts, fines, heavy metals and various organic and inorganic contaminants). Therefore, the first 5-10 mm of rainfall (first flush) should be adequately treated with SuDS.

The minimum number of treatment stages will depend on the sensitivity of the receiving water body and the potential hazard associated with the proposed development SuDS Manual (CIRIA, 2015). The proposed development is a combination of Very Low (roof water) to Low hazard (runoff from car parking and road). The Site does not lie within an SPZ and therefore additional treatment stages are not required.

Table 10. Level of hazard

Hazard	Source of hazard
Very Low	Residential roof drainage
Low	Residential, amenity uses including low usage car parking spaces and roads, other roof drainage.
Medium	Commercial, industrial uses including car parking spaces and roads (excluding low usage roads, trunk roads and motorways).
High	Areas used for handling and storage of chemicals and fuels, handling of storage and waste (incl. scrap-yards).

The recommended minimum number treatment stages suggested for the different runoff waters identified for the proposed development is highlighted in the table below.

Table 11. Minimum number of treatment stages for runoff

		Sensitivity of the receiving water body		
		Low	Medium	High
Hazard	Low	1	1	1
	Med	2	2	2
	High	3	3	3

9 Proposed SuDS strategy

Sustainable drainage systems

DEFRA's non-statutory requirements for SuDS require the below ground drainage systems to have the capacity to accommodate at least the 1 in 30 year event and to manage the 1 in 100 year event without flooding of on-site buildings and substations. All runoff should be managed on-Site though for the 1 in 100 year event, accounting for the maximum impacts of climate change to ensure flood risk is not increased to third-parties.

A surface water drainage strategy (summarised in Section 2 of this report) includes the following SuDS features to intercept, attenuate and treat surface water runoff.

Primary SuDS Strategy:

Infiltration to ground is not achievable at the Site, and water features were not identified or available, therefore surface water runoff will be managed within SuDS features and discharged to the public sewer network.

Table 12. Proposed SuDS type, features, discharge location and rate restriction

SuDS type	Source control (interception) and attenuation SuDS.
SuDS features	Green roof, rain garden, permeable paving and attenuation tank.
Discharge location	Public surface water sewer network.
Discharge rate	1 l/s.

Table 13. Proposed SuDS sizing (dimensions) and attenuation volumes

Rainwater Harvesting	To comply with London Plan policy, rainwater harvesting butts should be established for the proposed development. In terms of attenuation storage within this SuDS scheme, the volume of run-off which could be attenuated by rainwater harvesting has not been considered within the Preliminary SuDS strategy.
Green Roof	A green roof covering a total area of 52 m^2 is proposed. This will provide amenity, biodiversity and water quality benefits while also helping slow down flows.
Permeable paving	A 163 m^2 area of permeable paving (underlain with a Type 3 aggregate material) within the proposed driveway areas to a depth of 0.3 m, with a 30% porosity would result in c. 14.67 m^3 attenuation.

Rain Garden	20 m^2 of rain gardens with a 0.4 m depth of soil and 0.2 m depth of porous (30% porosity) aggregate, including 0.1 m of storage above the topsoil would provide c. 3.20 m^3 attenuation.
Attenuation tank	An attenuation tank with a length of 5 m, width of 5 m and depth of 1 m under the lawn in the garden of the Site would result in c. 23.75 m^3 attenuation.
Total Attenuation Provided	41.62m^3
Total Attenuation Required	39.79 m^3
Freeboard Storage Provided	1.83 m^3

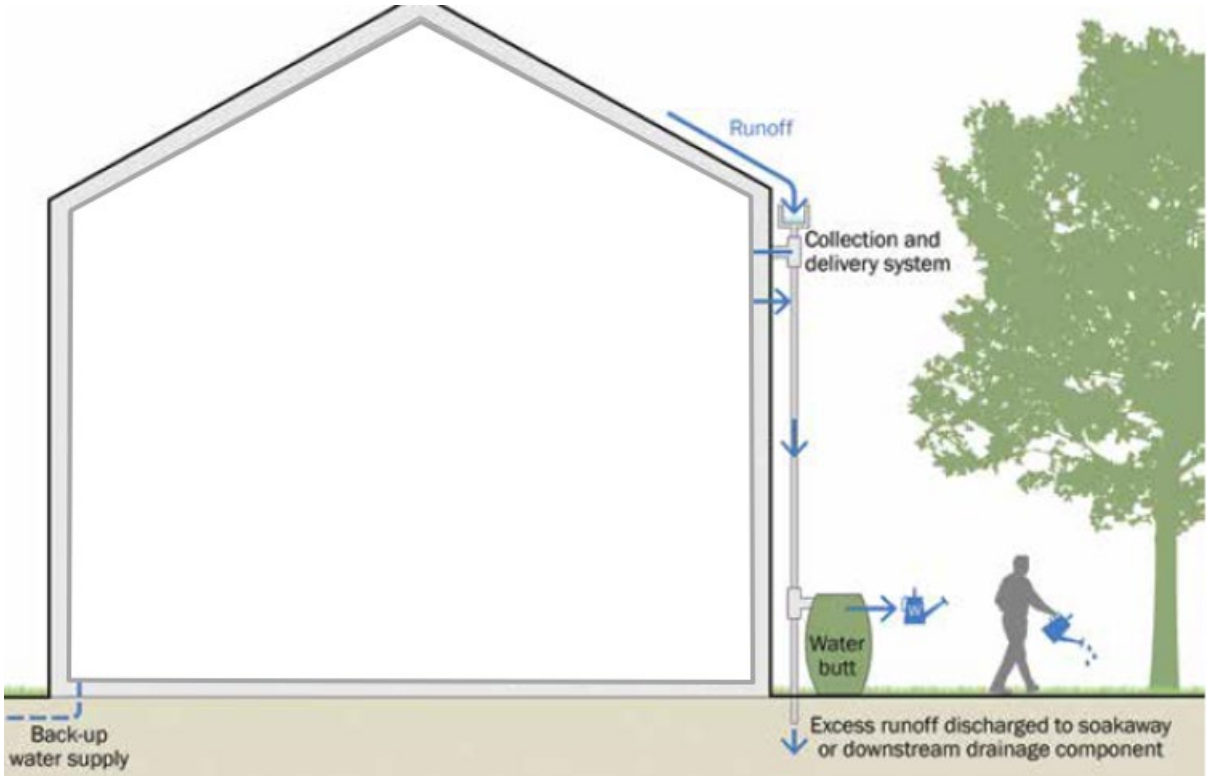
Rainwater harvesting

To comply with London Plan policy, a rainwater harvesting butt is proposed. The run-off from the proposed development roof should be led into rainwater harvesting butts via rainwater downpipes and guttering to catch run-off from the extension roof. Overflow from the butts should be discharged into the storage system provided by the permeable paving, rainwater gardens and the attenuation tank.

Due to the relatively insignificant amounts of attenuation provided by rainwater harvesting tanks in this instance and the requirement to retain water for non-potable uses such garden maintenance, the volume of run-off which could be attenuated by rainwater harvesting has not been considered within the report.

As there is an issue with the storage capability of rainwater harvesting tanks, this method should have a fixed attenuation volume and a controlled outlet to discharge into the proposed SuDS feature. An overflow system will be required for implementation on the Site due to exceedance events (where the pumps fail or there is a blockage within the system / or the number of residents and subsequent water usage is reduced).

Roof run-off is generally less polluted than run-off from road surfaces but can still generate pollutants such as sediments. Pollutants would be captured by the collection and filtration system and, by reducing the volume of run-off generated from the Site. Primary screening devices are used to prevent leaves and other debris from entering the butt and first flush devises can be designed to divert the first part of the rainfall away from the main storage tank and can pick up most of the dirt, debris and contaminates that collect on a residential roof.



Modified from Figure 11.3 of the CIRIA SuDS Manual (C753) (2015)

Green Roof

Green Roofs are proposed on the roofs of proposed residential dwellings which will aim to intercept and store runoff within a porous substrate (depth of 0.2 m) over a total area of 52 m^2.

Interception via green roofs will enable the storage of run-off and infiltrate collected water gradually into the underlying substrate; this provides various levels of storage depending on the surface area of the feature and the thickness. The different types of green roof include the following:

- Extensive roofs, have low substrate depths (and therefore low loadings on the building structure), simple planting and low maintenance requirements; these tend not to be accessible.
- Intensive roofs (or roof gardens) have deeper substrates (and therefore higher loadings on the building structure) that can support a wide variety of accessible planting but which tend to require more intensive maintenance.

Green roofs can also provide improvements to water quality as they intercept water at the source, and the layering of the substrate can incorporate filtration measures to remove pollutants from the system. Green Roofs are roofs which incorporate planting, often sedum or wildflower and meadow planting, grasses and mosses. In fact, some can even be planted with trees and shrubs. Brown roofs are similar to green roofs, the main difference is that whilst green roofs are often installed partly for the aesthetic value, brown roofs tend to be installed for environmental reasons, mainly, to encourage plants and wildlife.

In addition, although green roofs absorb most of the rainfall that they receive during frequent events, there will always be a need to discharge excess water to the building's drainage system and these areas should be positively drained. The hydraulic performance of green roofs once saturated tends to be fairly similar to standard roofs. Therefore, the hydraulic design of green roof drainage should follow the advice in BS EN 12056-3:2000. Useful information is also provided in BS 6229:2003. Detailed guidelines for the planning, execution and upkeep of green roof sites are contained within GRO (2014).

It is recommended that attenuation should be provided in the form of a high porosity substrate underlying the growing medium (approximately 50% depending on the supplier), which would provide sufficient storage (depending on loading requirements of a fully saturated substrate). It is likely that the high porosity medium would only have to be relatively thin in order to achieve the attenuation requirements. Surface water would then be throttled to a suitable rate at a downpipe entrance before discharging to the rainwater harvesting system.

Permeable paving

Permeable Paving is proposed for driveway and access path areas to intercept runoff. Suitable aggregate materials (angular gravels with suitable grading as per CIRIA, 2015) will improve water quality due to their filtration capacity and usually work to a 30% porosity. A geotextile layer will be required for paving underlain by aggregate material to intercept silt/particles. Permeable pavements are multi-layered surfacing systems. The surface layer is constructed out of permeable material allowing infiltration of water through gaps along its surface. A geomembrane isolates stored water from the surrounding soil, especially in contaminated areas and a geotextile layer prevents clogging and damage to the geo-cellular modules.

The geotextile layer works to intercept silt/particles flowing through the system via direct rainfall, or through vehicle use deposited onto the car park area and into the permeable paving. The majority of silt would be trapped within the top 30mm of the joining material between the paving blocks. Rainfall flowing into the permeable paving directly from the development roof/rainwater butts would not contain enough volumes of silt and or particles to cause blockage so will be fed directly into underlying porous substrate via rainwater pipes. Downpipes from the development roofs/rainwater butts should extend through the paving for c.5 meters to divert roof run-off away from building foundations. Paving could also implement an impermeable liner close to the building or creating a separate compartment within the permeable sub-base close to the building to further divert attenuated water away from building foundations.

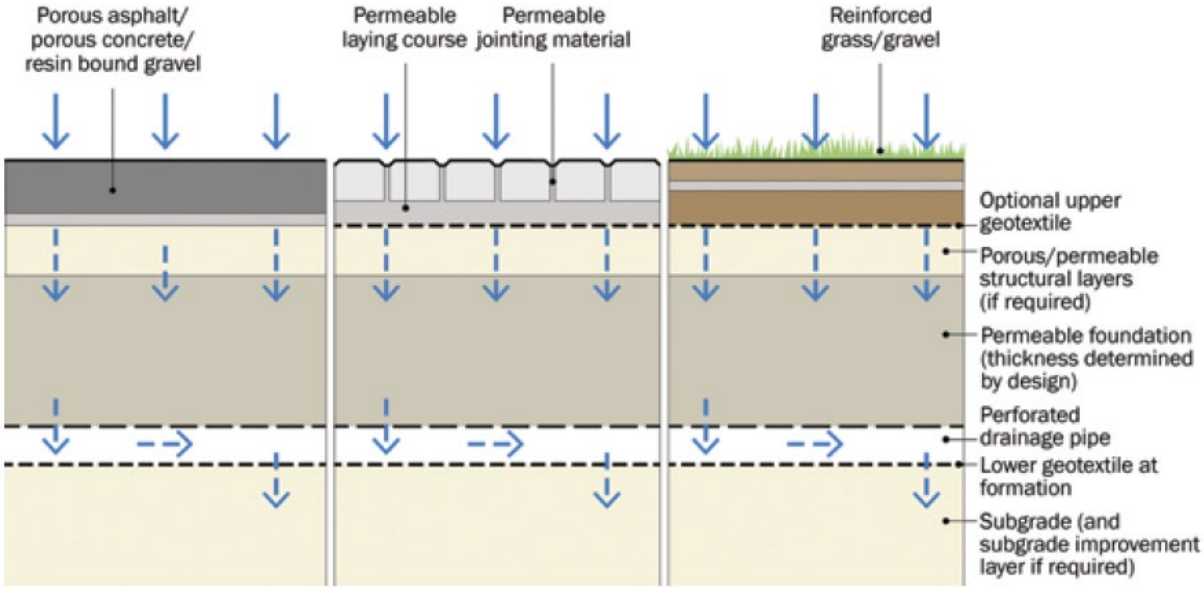


Figure 20.13 of the CIRIA SuDS Manual (C753) (2015)

Plastic geo-cellular systems could also be used, which can increase the void space and therefore storage but do not allow filtration unless they are combined with aggregate material and/or permeable geotextiles which could increase their storage potential by up to 20%. Geo-cellular modules also have the added advantage of reducing the amount of aggregate sub base required, thus keeping costs lower.

Rain garden

Bio retention (Rain Garden) areas will be used to collect and store surface water prior to infiltration to ground. The bioretention area should provide an area to store and treat rainwater where water is either collected and returned to the conveyance system or infiltrated if applicable. As the Site is not suitable for full infiltration, the bioretention area needs to be geared towards attenuation over infiltration.

The bio retention area would be located to the front of the Site as it is an appropriate SuDS development to reduce run-off levels that will not increase flood risk. This feature will reduce surface run-off by intercepting the first 5 mm of rain to reduce the volume of water running off-Site.

The main functions of the elements of the system comprises the inlet, which allows water to evenly distribute water into the filter system. The vegetation will influence the performance of the system through direct uptake of pollutants and by facilitating physical and chemical processed in the soil that removes nutrients. The filter medium is normally sand based which also works to filter out pollutants but also controls the rate at which water filter through the system. This medium is usually 750-1000mm thick through can be reduced for smaller catchments (minimum depth – 400mm). The transition layer is required to prevent washing of fines from the filter medium into the drainage layer and must be at least 100mm deep. The drainage layer is used to collect water from the filter medium to allow for access into the perforated pipes.

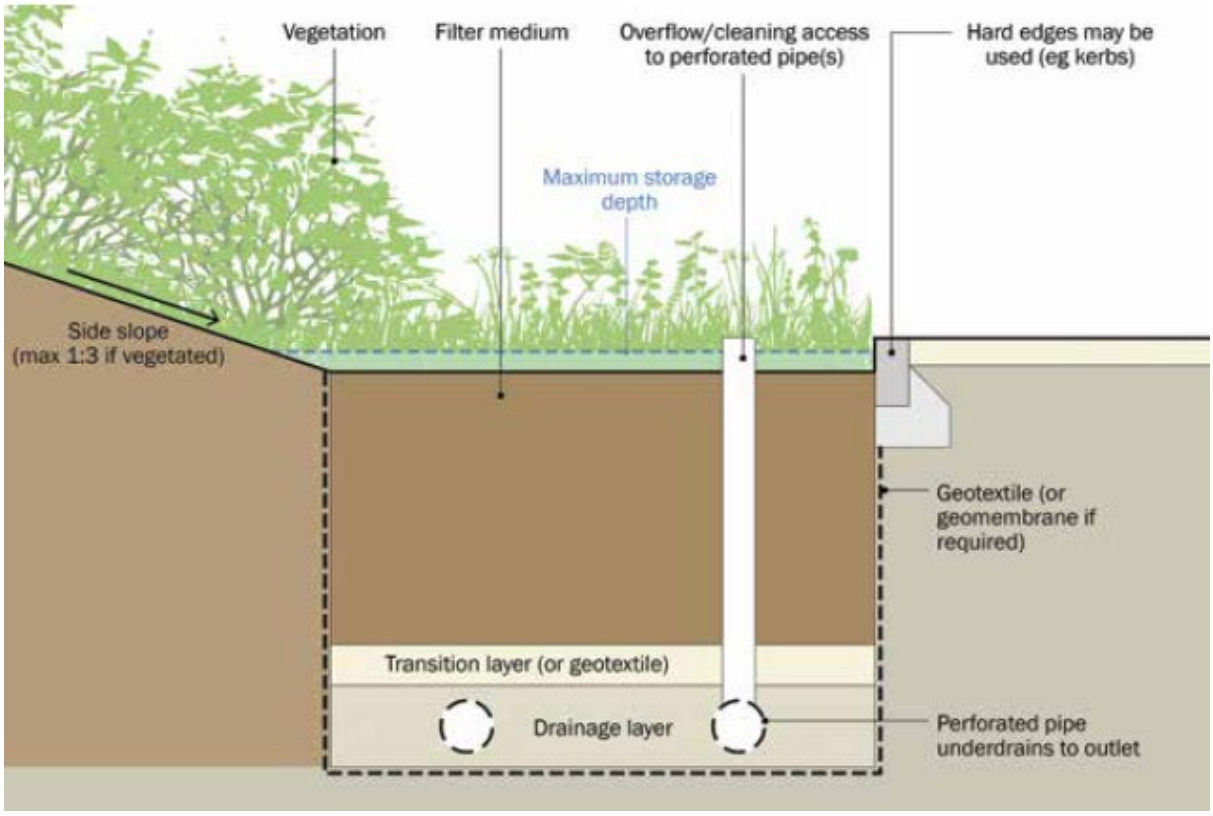


Figure 18.1 of the CIRIA SuDS Manual (C753) (2015)

Attenuation Tanks

Attenuation tanks are proposed to provide the storage required. Attenuation tanks provide a below-ground void space for use of temporary storage via controlled release. They can also be modified to suit specific characteristics of a site. DEFRA, 2015 states that the run-off volume from the development to drain to any sewer of surface water body in the 1 in 100 year rainfall event must be constrained to a value as close as is reasonably practical to the greenfield runoff volume for the same event but should never exceed the runoff volume from the development prior to redevelopment from the Site. Issues with attenuation tanks are the level of accessibility, lack of treatment performance and cost in comparison to surface systems.

Flow control devices and systems

Hydrobrake Flow control systems can be used to reduce the runoff rate from the Site. These are usually a device used for controlling water flow into a connecting feature, such as a sewer, to a specific attenuation performance. The design consists of an intake, a volute and an outlet and the configuration is critical to ensure discharge control. For drainage areas which are less than 3 ha, outlet throttle diameters would have to be small (<150mm diameter) to achieve outflow rates which could result in blockage. For most SuDS features, a flow control device will comprise a fixed orifice or a throttle such as a short pipe.

A Vortex Control is usually a self-activating vortex flow device which directs water into a volute to form a vortex. For the Site, rainwater down pipes from the development roof should drain directly into the attenuation feature to reduce infill from potential flood water.

Drainage protection devices

A non-return flap value is recommended for outflow pipes to reduce the risk of backflow from the sewer during a large scale rainfall event.

Exceedance Flows

Exceedance flow routes are included within the proposed SuDS drainage layout. Where possible, exceedance flows should be directed away from buildings and into non-essential areas of the Site rear garden and the driveway. The SuDS system recommended for the Site should provide enough storage that this method would only be utilised during a worst case scenario.

10 SuDS maintenance

Regular maintenance is essential to ensure effective operation of the SuDS features over the intended lifespan of the proposed development. The SuDS Manual (C753) (CIRIA, 2015) provides a maintenance schedule for SuDS with details of the necessary required actions as shown in the Table below.

Table 14. SuDS operation and recommended maintenance requirements

Asset type	Maintenance schedule (and frequency)
Permeable pavements	Regular maintenance: • Brushing and vacuuming (three times per year). • Trimming any roots and surrounding grass and weeds that may be causing blockages (annually or as required). Monitoring: • Initial inspection (monthly). • Inspect for poor performance and inspection chambers (annually).
Hydro-Brake Flow Control	Low amounts of maintenance required as there are no moving parts within the Hydro-Brake® Flow Control. • Initial monthly inspection at the manhole once the construction phase is over. If blockages occur they normally do so at the intake. Hydro-Brake® Flow Controls are fitted with a pivoting by-pass door, which allows the manhole chamber to be drained down should blockages occur. Inspection should be undertaken annually or when a storm event occurs.
Underground drainage pipe network	Regular maintenance: • Remove sediment and debris from pre-treatment devices and floor of inspection tube or chamber (annually). • Cleaning of gutters and any filters on downpipes (annually). • Trimming any roots that may be causing blockages (annually or as required). Monitoring: • Inspect silt traps and note rate of sediment accumulation (monthly in the first year and then annually).
Green Roof	Regular inspection: • Inspect all components (soil substrate, vegetation, drainage, irrigation systems, membranes and roof structure, waterproofing, structural stability (annually and after severe storms)

Asset type	Maintenance schedule (and frequency)
	• Inspect soil substrate for evidence of erosion channels (annually and after severe storms). • Inspect drain inlets for unrestricted run-off (annually and after severe storms). • Inspect underside of roof for leakage (annually and after severe storms). Regular maintenance: • Remove litter and debris from inlet drains (six monthly, annually or as required). • Cleaning of clippings (six monthly or as required). • Trimming of grasses and removal of nuisance weeds and invasive vegetation (six monthly or as required). • Replace dead plants (annually or as required). Monitoring: • Stabilise any erosion channels with extra soil substrate (as required). • Identify sources of erosion and control (as required). • Investigate and repair drain inlet if inlet has settled, cracked or moved (as required).
Rainwater Harvesting	Regular maintenance: • Inspection of tank for debris and sediment build up (annually and following poor performance). • Inspection of inlets, outlets, overflow areas, pumps and filters (annually and following poor performance). • Cleaning of tank, inlets, outlets, gutters, roof drain filters and withdrawal devices (annually or as required). Remedial actions: • Repair or overflow erosion damage or damage to tank and associated components (as required)
Rain garden	Regular maintenance: • Remove litter and debris from basin (monthly). • Trimming any roots and surrounding grass blockages (as required). Monitoring: • Inspect inlets, outlets and overflows for blockages,(monthly or after a heavy storm). • Inspect inlets and outlets for silt accumulation (half yearly). • Inspect infiltration surfaces for compaction and ponding (monthly).

Asset type	Maintenance schedule (and frequency)
Attenuation Tank	Regular maintenance: • Remove litter and debris from inlets and outlets (monthly). • Trimming any roots and surrounding grass blockages (as required). Monitoring: • Inspect inlets, outlets and overflows for blockages (monthly or after a heavy storm). • Inspect inlets and outlets for silt accumulation (half yearly). • Inspect infiltration surfaces for compaction and ponding (monthly).

Client checklist

A drainage strategy has been recommended as suitable on the basis of the information provided. Prior to installation of the Site drainage system it is recommended that the client carries out the following checks to confirm the development proposals. GeoSmart would be able to support with any updates required to the drainage scheme, please contact us and we would be happy to provide you with a proposal to undertake the work.

Table 15. Potential SuDS limitations

Conditions in Non-Statutory Technical Standards (Defra, 2015), limitations to infiltration SuDS	Do these conditions arise at the Site?
Is the surface runoff greater than the rate at which water can infiltrate into the ground?	
Is there an unacceptable risk of ground instability?	
Is there an unacceptable risk of mobilising contaminants?	
Is there an unacceptable risk of pollution to groundwater?	
Is there an unacceptable risk of groundwater flooding?	
Is the infiltration system going to create a high risk of groundwater leakage to the combined sewer?	

Table 16. SuDS design considerations

Confirm that potential flooding on-Site in excess of the design storm event and exceedance flow routes have been considered.	

Review options for the control of discharge rates (e.g. hydrobrake).	
Confirm the owners/adopters of the drainage system. Consider management options for multiple owners.	
Is there an unacceptable risk of pollution to groundwater?	
Review access and way leave requirements.	
Review maintenance requirements.	

Health and safety considerations for SuDS

GeoSmart reports may include outline strategies or designs to support with development plans. Any drawings or advice provided do not comprise any form of detailed design. Implementation of any conceptual scheme options may constitute 'Construction Work' as defined by CDM Regulations (2015).

The CDM Regulations place specific Health and Safety duties on those commissioning, planning and undertaking construction works. If you are uncertain what this means you should seek the advice of your architect, builder or other competent professional.

GeoSmart does not provide health and safety advisory services but we are required to advise you of your general responsibilities under CDM (visit http://geosmartinfo.co.uk/knowledge-hub/cdm-2015/ for more information).

Please remember that detailed design work should be undertaken by a competent professional who might be your engineer, architect, builder or another competent party.

11 Methodology and limitations of study

This report assesses the feasibility of infiltration SuDS and alternative drainage strategies in support of the Site development process. From April 6th 2015 SuDS are regulated by Local Planning Authorities and will be required under law for major developments in all cases unless demonstrated to be inappropriate. What is considered appropriate in terms of costs and benefits by the Planning Authority will vary depending on local planning policy, and Site setting. The Lead Local Flood Authority will require information as a statutory consultee on major planning applications with surface water drainage implications. The National Planning Policy Framework requires that new developments in areas at risk of flooding should give priority to the use of SuDS and demonstrate that the proposed development does not increase flood risk downstream to third parties.

How was the suitability of SuDS estimated for the Site?

There are a range of SuDS options available to provide effective surface water management that intercept and store excess runoff. When considering these options, the destination of the runoff should be assessed using the order of preference outlined in the Building Regulations Part H document (HM Government, 2010) and Defra's National Standards for SuDS (2015):

1. Discharge to the ground;
2. Discharge to a surface water body;
3. Discharge to a surface water sewer;
4. Discharge to a local highway drain; and
5. Discharge to a combined sewer.

Data sets relating to each of the potential discharge options have been analysed to assess the feasibility of each option according to the hierarchy set out above. Hydrogeological characteristics for the Site are assessed in conjunction with the occurrence of SPZ's to assess infiltration suitability. The Site has been screened to determine whether flood risk from groundwater, surface water, fluvial or coastal sources may constrain SuDS. The distance to surface water bodies and sewers has been reviewed gauge whether these provide alternative options.

GeoSmart SuDS Infiltration Suitability Map (SD50)

The GeoSmart SuDS Infiltration Suitability Map (SD50) screens the suitability for infiltration drainage in different parts of the Site and indicates where further assessment is recommended. In producing the SuDS Infiltration Suitability Map (SD50), GeoSmart used data from the British Geological Survey on groundwater levels, geology and permeability to screen

for areas where infiltration SuDS may be suitable. The map classifies areas into 3 categories of High, Medium and Low suitability for infiltration SuDS. This can then be used in conjunction with additional data on Site constraints to give recommendations for SuDS design and further investigation.

The primary constraint on infiltration potential is the minimum permeability of the underlying material and in some cases the range in permeability may be considerable, ranging down to low. The map classifies these areas as moderate infiltration suitability requiring further investigation. In cases where the thickness of the receiving permeable horizon is less than 1.5 meters then additional Site investigation is recommended. If the Site is at risk of groundwater flooding for up to the 1% annual occurrence the map classifies these areas as moderate infiltration suitability requiring further investigation.

The GeoSmart SuDS Infiltration Suitability Map (SD50) is a national screening tool for infiltration SuDS techniques but a Site specific assessment should be used before final detailed design is undertaken. Further information on the GeoSmart SuDS Infiltration Suitability Map (SD50) is available at geosmartinfo.co.uk

How is the suitability to discharge to sewers and watercourses calculated?

The suitability to discharge to discharge to sewers and watercourses has been calculated using the distance from the Site to both. For example, where the Site is within 50 m of a surface water body. Discharge to surface water is potentially appropriate subject to land access arrangements and a feasibility assessment. Where the Site is within 50 m of a sewer, discharge to sewer is potentially appropriate subject to land access arrangements and a feasibility assessment. The utility company should be contacted to agree connection feasibility and sewer capacity.

Further information relating to sewers available in the area can be found in Appendix C.

What is a Source Protection Zone?

The Environment Agency have defined Source Protection Zones (SPZs) for 2000 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. The maps show three main zones (inner, outer and total catchment) and a fourth zone of special interest, which is occasionally applied. The zones are used to set up pollution prevention measures in areas which are at a higher risk. The shape and size of a zone depends on the condition of the ground, how the groundwater is removed, and other environmental factors. Inner zone (Zone 1) is defined as the 50 day travel time from any point below the water table to the source (minimum radius of 50 metres). Outer zone (Zone 2) is defined by a 400 day travel time. Total catchment (Zone 3) is defined as the area around a source within which all groundwater recharge is presumed to be discharged at the source.

How was surface water runoff estimated from the Site?

In accordance with The SuDS Manual (C753) (CIRIA, 2015), the Greenfield runoff from the Site has been calculated using the IoH124 method and is assumed representative of the runoff generated on the undeveloped surfaces that are affected by the proposed development. The method used for calculating the runoff complies with the NPPF (MHCLG, 2023). For the impermeable surfaces, it has been assumed that 100% runoff will occur (calculations provided in Appendix B). Rainfall data is derived from the Flood Estimation Handbook (FEH), developed by NERC (2009). Only areas affected by the proposed development are considered in the flow and volume calculations. Permeable areas that remain unchanged are not included in the calculations as it is assumed these will not be actively drained and attenuated.

What is the peak discharge rate?

An estimation of peak runoff flow rate and volume is required to calculate infiltration, storage and discharge requirements. The peak discharge rate is the maximum flow rate at which surface water runoff leaves the Site during a particular storm event, without considering the impact of any mitigation such as storage, infiltration or flow control. Proposed discharge rates (with mitigation) should be no greater than existing rates for all corresponding storm events. If all drainage is to infiltration there will be no discharge off-Site. Discharging all flow from Site at the existing 1 in 100 event would increase flood risk during smaller events. Flow restriction is generally required to limit the final discharge from Site during all events as a basic minimum to the green field QBAR rate. A more complex flow restriction which varies the final discharge rate from the Site depending on the storm event will reduce the volume of storage required on-Site. Drainage to infiltration SuDS is subtracted from the total discharge off-Site to achieve a beneficial net affect.

What is the total discharge volume?

The total discharge volume is calculated on the basis of the surface water runoff that has the potential to leave the Site as a result of the assumed 6 hour duration design storm event. The runoff is related to the underlying soil conditions, impermeable cover, rainfall intensity and duration of the storm event. The total volume generated by the current Site is compared to the potential total volume from the developed Site (not taking into consideration any mitigation). The difference provides the minimum total volume that will need to be stored and infiltrated on-Site or released at a controlled rate. Guidance indicates that the total discharge volume should never exceed the runoff volume from the development Site prior to redevelopment for that event and should be as close as is reasonably practicable to the Greenfield runoff volume.

12 Background SuDS information

SuDS control surface water runoff close to where it falls. SuDS are designed to replicate, as closely as possible, the natural drainage from the Site before development to ensure that the flood risk downstream does not increase as a result of the Site being developed, and that the Site will have satisfactory drainage under current and likely future climatic conditions. SuDS provide opportunities to reduce the causes and impacts of flooding; remove pollutants from urban runoff at source; and combine water management with green space with benefits for amenity, recreation and wildlife. Government planning policy and planning decisions now include a presumption in favour of SuDS being used for all development Sites, unless they can be shown to be inappropriate.

For general information on SuDS see our website: http://geosmartinfo.co.uk/

Infiltration SuDS

Government policy for England is to introduce sustainable drainage systems (SuDS) via conditions in planning approvals. Guidance indicates that capturing rainfall runoff on-Site and infiltrating it into the ground (infiltration SuDS) is the preferred method for managing surface water without increasing flood risk downstream.

The greatest benefit to general flood risk is if all runoff is infiltrated on-Site, however, this may not be feasible due to physical and economic constraints in which case infiltration may be considered as a part of an integrated drainage solution. The final design capacity for an infiltration SuDS system depends on the Site constraints and the requirements of the individual Planning Authority and the Lead Local Flood Authority.

The capacity of the ground to receive infiltration depends on the nature, thickness and permeability of the underlying material and the depth to the high groundwater table. The final proportion of the Site drained by infiltration will depend on topography, outfall levels and a suitable drainage gradient. It is important to note that, even if the whole Site cannot be drained by infiltration, the use of partial infiltration is encouraged, with the remainder of runoff discharged via other SuDS systems.

Types of infiltration SuDS

Infiltration components include infiltration trenches, soakaways, swales and infiltration basins without outlets, rain gardens and permeable pavements. These are used to capture surface water runoff and allow it to infiltrate (soak) and filter through to the subsoil layer, before returning it to the water table below.

An infiltration trench is usually filled with permeable granular material and is designed to promote infiltration of surface water to the ground. An infiltration basin is a dry basin or depression designed to promote infiltration of surface water runoff into the ground. Soakaways are the most common type of infiltration device in the UK where drainage is often connected to over-sized square or rectangular, rubble-filled voids sited beneath lawns.

According to the guidance in Building Research Establishment (BRE) Digest 365 (2016) a soakaway must be able to discharge 50% of the runoff generated during a 1 in 10 year storm event within 24 hours in readiness for subsequent storm flow. This is the basic threshold criteria for a soakaway design and the internal surface area of the proposed soakaway design options should be calculated on this basis by taking into account the soil infiltration rate for the Site.

Developers need to ensure their design takes account of the construction, operation and maintenance requirements of both surface and subsurface components, allowing for any machinery access required.

SuDS maintenance and adoption

Regular maintenance is essential to ensure effective operation of the soakaway(s) over the intended lifespan of the proposed development. A maintenance schedule for SuDs is required. Sewerage undertakers or Local Authorities may adopt SuDS and will require maintenance issues to be dealt with in accordance with their Management Plan. If the SuDS will not be adopted other provision is required with associated financial implications. Maintenance is a long-term obligation requiring the upkeep of all elements of the SuDS, including mechanical components (e.g. pumps), as well as inspections, regular maintenance and repair.

Additional background SuDS information can be found on our website: http://geosmartinfo.co.uk/

13 Further information

The following table includes a list of additional products by GeoSmart:

Additional GeoSmart Products			
✓	Additional assessment: FloodSmart Report		The FloodSmart Report range provides clear and pragmatic advice regarding the nature and potential significance of flood hazards which may be present at a Site. Our consultants assess available data to determine the level of risk based on professional judgement and years of experience. Please contact info@geosmartinfo.co.uk for further information.
✓	Additional assessment: EnviroSmart Report		Provides a robust desk-based assessment of potential contaminated land issues, taking into account the regulatory perspective. Our EnviroSmart reports are designed to be the most cost effective solution for planning conditions. Each report is individually prepared by a highly experienced consultant conversant with Local Authority requirements. Ideal for pre-planning or for addressing planning conditions for small developments. Can also be used for land transactions. Please contact info@geosmartinfo.co.uk for further information.

14 References and glossary

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Thames Water (2024). (11 Yeading Lane) Asset Location Plan. Ref: ALS/ALS Standard/2024_5041029

GeoSmart Information

Glossary

General terms

Attenuation	Reduction of peak flow and increased duration of a flow event.
Combined sewer	A sewer designed to carry foul sewage and surface water in the same pipe.
Detention basin	A vegetated depression, normally is dry except after storm events, constructed to store water temporarily to attenuate flows. May allow infiltration of water to the ground.
Evapotranspiration	The process by which the Earth's surface or soil loses moisture by evaporation of water and by uptake and then transpiration from plants.
FEH	Flood Estimation Handbook, produced by Centre for Ecology and Hydrology, Wallingford (formerly the Institute of Hydrology).
Filter drain or trench	A linear drain consisting of a trench filled with a permeable material, often with a perforated pipe in the base of the trench to assist drainage, to store and conduct water, but may also be designed to permit infiltration.
First flush	The initial runoff from a site or catchment following the start of a rainfall event. As runoff travels over a catchment it will collect or dissolve pollutants, and the "first flush" portion of the flow may be the most contaminated as a result. This is especially the case for intense storms and in small or more uniform catchments. In larger or more complex catchments pollution.
Flood plain	Land adjacent to a watercourse that would be subject to repeated flooding under natural conditions (see Environment Agency's Policy and practice for the protection of flood plains for a fuller definition).
Greenfield runoff	This is the surface water runoff regime from a site before development, or the existing site conditions for brownfield redevelopment sites.
Impermeable surface	An artificial non-porous surface that generates a surface water runoff after rainfall.
Permeability	A measure of the ease with which a fluid can flow through a porous medium. It depends on the physical properties of the medium, for example grain size, porosity and pore shape.

Runoff	Water flow over the ground surface to the drainage system. This occurs if the ground is impermeable, is saturated or if rainfall is particularly intense.
Sewerage undertaker	This is a collective term relating to the statutory undertaking of water companies that are responsible for sewerage and sewage disposal including surface water from roofs and yards of premises.
Soakaway	A subsurface structure into which surface water is conveyed to allow infiltration into the ground.
Treatment	Improving the quality of water by physical, chemical and/or biological means.

The terms included in this glossary have been taken from CIRIA (2015) guidance.

GeoSmart Information

Data Sources

Aerial Photography	Contains Ordnance Survey data © Crown copyright and database right 2024 BlueSky copyright and database rights 2024
Bedrock & Superficial Geology	Contains British Geological Survey materials © NERC 2024 Ordnance Survey data © Crown copyright and database right 2024
Flood Risk (RoFRS/Pluvial/Surface Water Features/SPZ)	Environment Agency copyright and database rights 2024 Ordnance Survey data © Crown copyright and database right 2024
Flood Risk (Groundwater) and SuDS infiltration suitability (SD50)	GeoSmart, BGS & OS GW5 (v2.4) Map (GeoSmart, 2024) Contains British Geological Survey materials © NERC 2024 Ordnance Survey data © Crown copyright and database right 2024
Sewer Location	Contains Ordnance Survey data © Crown copyright and database right 2024 Contains Thames Water Property Search data 2024
Topographic Data	OS LiDAR/EA Contains Ordnance Survey data © Crown copyright and database right 2024 Environment Agency copyright and database rights 2024

15 Appendices

GeoSmart Information

Appendix A

Site plans

0 2m 4m 10m 20m

SCALE BAR 1:200

EXISTING BLOCK PLAN
SCALE 1:200

Rev	Date	Description	Init.
-	-	-	-

Client

MR RAYAT

Project Title

PROPOSED REDEVELOPMENT OF THE SITE

11 YEADING LANE, HAYES, UB4 0EL

Drawing Title

EXISTING BLOCK PLAN

Cad File	Sheet Size	Scale
P001	A1	1:200
Drawn by	Drawing Date	Approved by
BR	AUG 2023	NJ
Project No.	Drawing No.	Revision
1977	P102	-

Juttla Architects

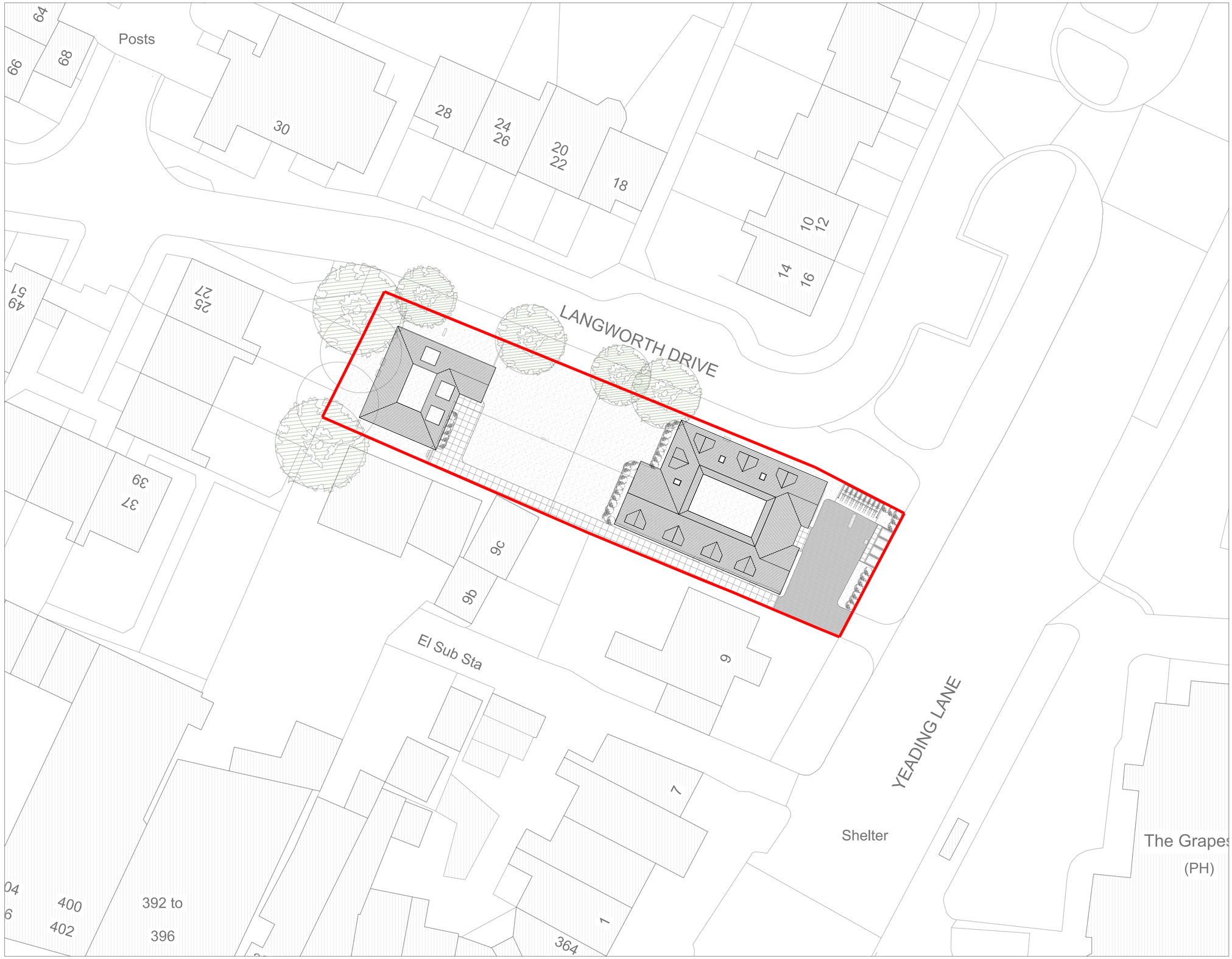
2-4 High Street Ruislip
Middlesex HA4 7AR

t 01923 840077 f 01923 840078
info@juttla-architects.com
juttla-architects.com

PLANNING ISSUE

0 2m 4m 10m 20m

SCALE BAR 1:200



PROPOSED BLOCK PLAN
SCALE 1:200

Rev	Date	Description	Init.
B	26.06.24	AMENDED TO SUIT CLIENTS COMMENTS	BR
A	04.06.24	AMENDED TO SUIT PRE-APP	BR

Client

MR RAYAT

Project Title

PROPOSED REDEVELOPMENT OF THE SITE

11 YEADING LANE, HAYES, UB4 0EL

Drawing Title

PROPOSED BLOCK PLAN

Cad File	Sheet Size	Scale
P002	A1	1:200
Drawn by	Drawing Date	Approved by
BR	AUG 2023	NJ
Project No.	Drawing No.	Revision
1977	P103	B

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PLANNING ISSUE

0 1m 2m 5m 10m 20m

SCALE BAR 1:100

LOCATION PLAN
SCALE 1:1250

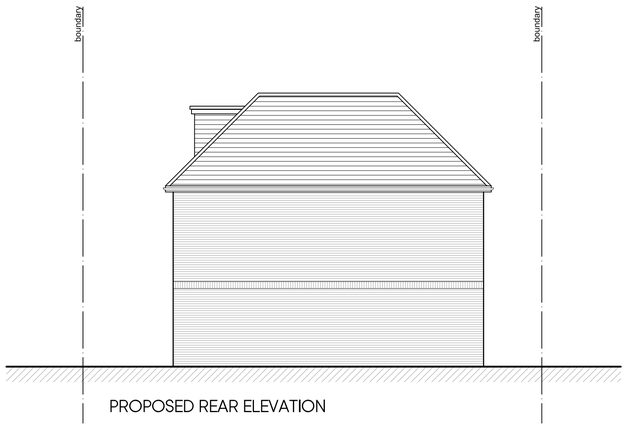
BUILDING 1

PROPOSED FRONT ELEVATION

PROPOSED REAR ELEVATION

BUILDING 2

PROPOSED FRONT ELEVATION



PROPOSED REAR ELEVATION

Rev	Date	Description	Init.
B	26.06.24	AMENDED TO SUIT CLIENTS COMMENTS	BR
A	04.06.24	AMENDED TO SUIT CLIENTS COMMENTS	BR

Client

MR RAYAT

Project Title

PROPOSED REDEVELOPMENT OF THE SITE

11 YEADING LANE, HAYES, UB4 0EL

Drawing Title

PROPOSED BUILDING 1 & 2 FRONT AND REAR ELEVATIONS

Cad File	Sheet Size	Scale
P002	A1	1:100
Drawn by	Drawing Date	Approved by
BR	AUG 2023	NJ
Project No.	Drawing No.	Revision
1977	P401	B

Juttla Architects

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info@juttla-architects.com
juttla-architects.com

PLANNING ISSUE

GeoSmart Information

Appendix B

Rainfall runoff calculations

Input parameters for run-off calculations		
Country	England	
Total site area	945	m^2
Area proposed for development	945	m^2
Current permeable ground cover	565	m^2
Current impermeable ground cover	380	m^2
Proposed permeable ground cover	368.6	m^2
Proposed impermeable ground cover	524	m^2
Urban Creep Allowance	10%	
Final impermeable ground cover	576.4	m^2
SPR	0.47	
SAAR	621	mm
Region	6	
Climate change factor	40%	
Discharge Rate (l/s)	1.0	
Run-off coefficient	100%	

Current impermeable area as % of total	40%
Proposed impermeable area as % of total	61%
Change in permeable area (m2)	-196
Change in impermeable area (m2)	196
Change in impermeable area as % of total	21%

Rainfall event	Greenfield run-off rates (l/s)	Existing run-off rates(l/s)	Potential run-off rates without attenuation (l/s)	Potential minus exisiting (l/s)
QBAR	0.40	N/A	N/A	N/A
6 hour 1 in 1 year	0.34	0.74	0.86	0.12
6 hour 1 in 10 year	0.64	1.27	1.47	0.20
6 hour 1 in 30 year	0.89	1.66	1.93	0.27
6 hour 1 in 100 year	1.27	2.17	2.52	0.35
6 hour 1 in 100 year + 20% CC	N/A	N/A	3.02	0.85
6 hour 1 in 100 year + 40% CC	N/A	N/A	3.53	1.36

Rainfall event	Greenfield run-off volume (m^3)	Existing run-off volume (m^3)	Potential run-off volume without attenuation (m^3)	Potential minus existing (m^3)
QBAR	11.80	N/A	N/A	N/A
6 hour 1 in 1 year	10.97	15.94	18.51	2.57
6 hour 1 in 10 year	19.21	27.50	31.78	4.28
6 hour 1 in 30 year	24.73	35.94	41.74	5.80
6 hour 1 in 100 year	32.24	46.85	54.41	7.55
6 hour 1 in 100 year + 20% CC	N/A	N/A	65.29	18.44
6 hour 1 in 100 year + 40% CC	N/A	N/A	76.17	29.32

Return Period	Runoff rate restriction (l/s)	Critical Storm Duration (hr)	Attenuation Volume Required (m^3)	Volume required above previous return period
1 in 30 year	1.00	2.00	17.80	N/A
6 hour 1 in 100 year	1.00	3.00	25.33	7.53
6 hour 1 in 100 year + 40% CC	1.00	3.00	39.79	14.45

GeoSmart Information

Appendix C

Thames Water Asset Location Plan

Asset Location Search

Thames Water Property Searches

GeoSmart Information Ltd
1st Floor Old Bank Buildings
Suite 9-11Bellstone
SHREWSBURY
SY1 1HU

Search address supplied 11
Yeading Lane
Hayes
UB4 0EL

Your reference 83133

Our reference ALS/ALS Standard/2024_5041029

Search date 27 August 2024

Notification of Price Changes

From 1st April 2024 Thames Water Property Searches will be increasing the prices of its CON29DW Residential and Commercial searches along with the Asset Location Search. Costs will rise in line with RPI as per previous years, which is sat at 6%.

Customers will be emailed with the new prices by February 28th 2024.

Any orders received with a higher payment prior to the 1st April 2024 will be non-refundable. For further details on the price increase please visit our website at www.thameswater-propertysearches.co.uk.

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

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

0800 009 4540

Asset Location Search

Property Searches

Search address supplied: 11, Yeading Lane, Hayes, UB4 0EL

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 search provides 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 0800 009 4540, 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.

With regard to the fresh water supply, this site falls within the boundary of another water company. For more information, please redirect your enquiry to the following address:

Affinity Water Ltd
Tamblin Way
Hatfield
AL10 9EZ
Tel: 0345 3572401

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

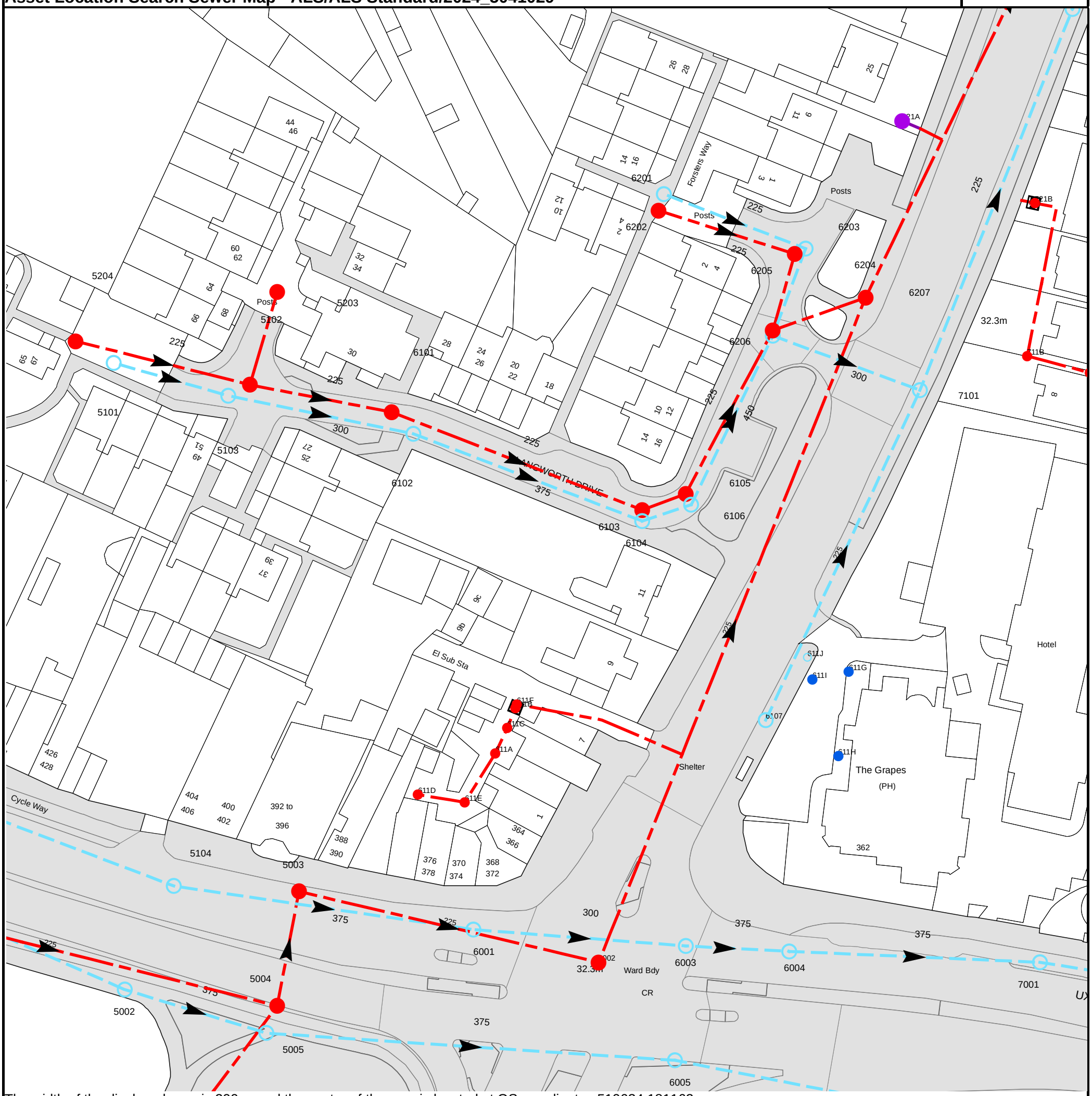
Clean Water queries

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/2024_5041029



The width of the displayed area is 200 m and the centre of the map is located at OS coordinates 510634,181162

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
611B	n/a	n/a
6107	n/a	n/a
611J	n/a	n/a
611I	n/a	n/a
611H	n/a	n/a
611G	n/a	n/a
5203	n/a	n/a
6101	n/a	n/a
6102	n/a	n/a
611F	n/a	n/a
6104	n/a	n/a
6103	n/a	n/a
6202	n/a	n/a
6201	n/a	n/a
6105	n/a	n/a
6106	n/a	n/a
6206	n/a	n/a
6205	n/a	n/a
6204	n/a	n/a
6203	n/a	n/a
6207	32.45	29.59
621A	n/a	n/a
7101	32.53	30.73
711B	n/a	n/a
721B	n/a	n/a
7201	32.02	30
711A	n/a	n/a
6005	n/a	n/a
5005	32.82	31.12
5004	32.74	30.6
7001	32.14	30.43
6002	32.38	30.18
6004	32.18	30.57
6003	n/a	n/a
6001	32.4	30.72
5003	32.66	30.69
611E	n/a	n/a
611D	n/a	n/a
611A	n/a	n/a
611C	n/a	n/a
5204	n/a	n/a
5101	n/a	n/a
5002	32.91	31.28
5104	32.98	31.18
5103	n/a	n/a
5102	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.

Asset Location Search - Sewer Key

Public Sewer Types (Operated and maintained by Thames Water)

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

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

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

- Storm Sewer
- Sludge Sewer
- Foul Trunk Sewer
- Surface Trunk Sewer
- Combined Trunk Sewer
- Foul Rising Main
- Surface Water Rising Main
- Combined Rising Main
- Vacuum
- Thames Water Proposed
- Vent Pipe
- Gallery

Other Sewer Types (Not operated and maintained by Thames Water)

- Sewer
- Culverted Watercourse
- Proposed
- Decommissioned Sewer
- Content of this drainage network is currently unknown
- Ownership of this drainage network is currently unknown

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
- Meter
- Dam Chase
- Vent
- Fitting

Operational Controls

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

- Ancillary
- Drop Pipe
- Control Valve
- 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.

- Inlet
- Outfall
- Undefined End

Other Symbols

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

- Change of Characteristic Indicator
- Public / Private Pumping Station
- Invert Level
- Summit

Areas

Lines denoting areas of underground surveys, etc.

- Agreement
- Chamber
- Operational Site

Ducts or Crossings

- Casement

Ducts may contain high voltage cables. Please check with Thames Water.

- Conduit Bridge
- Subway
- Tunnel

Notes:

1) All levels associated with the plans are to Ordnance Datum Newlyn.
2) All measurements on the plan are metric.
3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate the 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 indicates that data is unavailable.
6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in millimeters. 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, please contact Property Searches on 0800 009 4540.

Payment Terms and Conditions

All sales are made in accordance with Thames Water Utilities Limited (TWUL) standard terms and conditions unless previously agreed in writing.

1. All goods remain in the property of Thames Water Utilities Ltd until full payment is received.
2. Provision of service will be in accordance with all legal requirements and published TWUL policies.
3. All invoices are strictly due for payment within 14 days of the date of the invoice. Any other terms must be accepted/agreed in writing prior to provision of goods or service or will be held to be invalid.
4. Penalty interest may be invoked by TWUL in the event of unjustifiable payment delay. Interest charges will be in line with UK Statute Law 'The Late Payment of Commercial Debts (Interest) Act 1998'.
5. Interest will be charged in line with current Court Interest Charges, if legal action is taken.
6. A charge may be made at the discretion of the company for increased administration costs.

A copy of Thames Water's standard terms and conditions are available from the Commercial Billing Team (cashoperations@thameswater.co.uk).

We publish several Codes of Practice including a guaranteed standards scheme. You can obtain copies of these leaflets by calling us on 0800 980 8800.

If you are unhappy with our service, you can speak to your original goods or customer service provider. If you are still not satisfied with the outcome provided, we will refer the matter to a Senior Manager for resolution who will provide you with a response.

If you are still dissatisfied with our final response, and in certain circumstances such as you are buying a residential property or commercial property within certain parameters, The Property Ombudsman will investigate your case and give an independent view. The Ombudsman can award compensation of up to £25,000 to you if he finds that you have suffered actual financial loss and/or aggravation, distress, or inconvenience because of your search not keeping to the Code. Further information can be obtained by visiting www.tpos.co.uk or by sending an email to admin@tpos.co.uk.

If the Goods or Services covered by this invoice falls under the regulation of the 1991 Water Industry Act, and you remain dissatisfied you can refer your complaint to Consumer Council for Water on 0300 034 2222 or write to them at Consumer Council for Water, 1st Floor, Victoria Square House, Victoria Square, Birmingham, B2 4AJ.

Ways to pay your bill

Credit Card	**BACS Payment**	**Telephone Banking**
Please Call **0800 009 4540** quoting your invoice number starting CBA or ADS	Account number **90478703** Sort code **60-00-01** A remittance advice must be sent to: **Thames Water Utilities Ltd., PO Box 3189, Slough SL1 4WW.** or email **ps.billing@thameswater.co.uk**	By calling your bank and quoting: Account number **90478703** Sort code **60-00-01** and your invoice number

Disclaimer

This report has been prepared by GeoSmart in its professional capacity as soil, groundwater, flood risk and drainage specialists, with reasonable skill, care and diligence within the agreed scope and terms of contract and taking account of the manpower and resources devoted to it by agreement with its client and is provided by GeoSmart solely for the internal use of its client.

The advice and opinions in this report should be read and relied on only in the context of the report as a whole, taking account of the terms of reference agreed with the client. The findings are based on the information made available to GeoSmart at the date of the report (and will have been assumed to be correct) and on current UK standards, codes, technology and practices as at that time. They do not purport to include any manner of legal advice or opinion. New information or changes in conditions and regulatory requirements may occur in future, which will change the conclusions presented here.

This report is confidential to the client. The client may submit the report to regulatory bodies, where appropriate. Should the client wish to release this report to any other third party for that party's reliance, GeoSmart may, by prior written agreement, agree to such release, provided that it is acknowledged that GeoSmart accepts no responsibility of any nature to any third party to whom this report or any part thereof is made known. GeoSmart accepts no responsibility for any loss or damage incurred as a result, and the third party does not acquire any rights whatsoever, contractual or otherwise, against GeoSmart except as expressly agreed with GeoSmart in writing.

For full T&Cs see http://geosmartinfo.co.uk/terms-conditions

Further information

Information on confidence levels and ways to improve this report can be provided for any location on written request to info@geosmart.co.uk or via our website. Updates to our model are ongoing and additional information is being collated from several sources to improve the database and allow increased confidence in the findings. Further information on groundwater levels and flooding are being incorporated in the model to enable improved accuracy to be achieved in future versions of the map. Please contact us if you would like to join our User Group and help with feedback on infiltration SuDS and mapping suggestion.

Important consumer protection information

This search has been produced by GeoSmart Information Limited, Suite 9-11, 1st Floor, Old Bank Buildings, Bellstone, Shrewsbury, SY1 1HU.

Tel: 01743 298 100

Email: info@geosmartinfo.co.uk

GeoSmart Information Limited is registered with the Property Codes Compliance Board (PCCB) as a subscriber to the Search Code. The PCCB independently monitors how registered search firms maintain compliance with the Code.

The Search Code:

- provides protection for homebuyers, sellers, estate agents, conveyancers and mortgage lenders who rely on the information included in property search reports undertaken by subscribers on residential and commercial property within the United Kingdom.
- sets out minimum standards which firms compiling and selling search reports have to meet.
- promotes the best practice and quality standards within the industry for the benefit of consumers and property professionals.
- enables consumers and property professionals to have confidence in firms which subscribe to the code, their products and services.
- By giving you this information, the search firm is confirming that they keep to the principles of the Code. This provides important protection for you.

The Code's core principles

Firms which subscribe to the Search Code will:

- display the Search Code logo prominently on their search reports.
- act with integrity and carry out work with due skill, care and diligence.
- at all times maintain adequate and appropriate insurance to protect consumers.
- conduct business in an honest, fair and professional manner.
- handle complaints speedily and fairly.
- ensure that products and services comply with industry registration rules and standards and relevant laws.
- monitor their compliance with the Code.

GeoSmart Information

Complaints

If you have a query or complaint about your search, you should raise it directly with the search firm, and if appropriate ask for any complaint to be considered under their formal internal complaints procedure. If you remain dissatisfied with the firm's final response, after your complaint has been formally considered, or if the firm has exceeded the response timescales, you may refer your complaint for consideration under The Property Ombudsman scheme (TPOs). The Ombudsman can award up to £5,000 to you if the Ombudsman finds that you have suffered actual financial loss and/or aggravation, distress or inconvenience as a result of your search provider failing to keep to the Code.

Please note that all queries or complaints regarding your search should be directed to your search provider in the first instance, not to TPOs or to the PCCB.

TPOs contact details:

The Property Ombudsman scheme

Milford House

43-55 Milford Street

Salisbury

Wiltshire SP1 2BP

Tel: 01722 333306

Fax: 01722 332296

Email: admin@tpos.co.uk

You can get more information about the PCCB from www.propertycodes.org.uk.

Please ask your search provider if you would like a copy of the search code

Complaints procedure

GeoSmart Information Limited is registered with the Property Codes Compliance Board as a subscriber to the Search Code. A key commitment under the Code is that firms will handle any complaints both speedily and fairly. If you want to make a complaint, we will:

- Acknowledge it within 5 working days of receipt.
- Normally deal with it fully and provide a final response, in writing, within 20 working days of receipt.
- Keep you informed by letter, telephone or e-mail, as you prefer, if we need more time.
- Provide a final response, in writing, at the latest within 40 working days of receipt.
- Liaise, at your request, with anyone acting formally on your behalf.

If you are not satisfied with our final response, or if we exceed the response timescales, you may refer the complaint to The Property Ombudsman scheme (TPOs): Tel: 01722 333306, E-mail: admin@tpos.co.uk.

We will co-operate fully with the Ombudsman during an investigation and comply with his final decision. Complaints should be sent to:

Martin Lucass

Commercial Director

GeoSmart Information Limited

Suite 9-11, 1st Floor,

Old Bank Buildings,

Bellstone, Shrewsbury, SY1 1HU

Tel: 01743 298 100

martinlucass@geosmartinfo.co.uk

16 Terms and conditions, CDM regulations and data limitations

Terms and conditions can be found on our website:

http://geosmartinfo.co.uk/terms-conditions/

CDM regulations can be found on our website:

http://geosmartinfo.co.uk/knowledge-hub/cdm-2015/

Data use and limitations can be found on our website:

http://geosmartinfo.co.uk/data-limitations/