MJA CONSULTING
Civil & Structural Engineers

PROPOSED REDEVELOPMENT
GROSVENOR GARAGE
FITZGERALD AVENUE
LONDON
SW14 8SZ

FLOOD RISK ASSESSMENT & DEVELOPMENT DRAINAGE STRATEGY

HESTIA HOMES

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DOCUMENT CONTROL RECORD

Document Control

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Contents

Appendices

1 Introduction

1.1 Scope

Hestia Homes is seeking planning permission for the redevelopment of the current Grosvenor Garage site off Fitzgerald Avenue in East Sheen, in the London Borough of Richmond.

The redevelopment proposals represent 'Minor Development' and comprise the demolition of all existing garage buildings within the site for the construction of up to 8No. residential dwellings (3No. houses and 5No. apartments) and commercial space.

1.2 MJA Consulting has been appointed to undertake a Flood Risk Assessment and Development Drainage Strategy to determine the potential flood risks associated with the site and to provide a suitable strategy for the disposal of surface and foul water from the proposed development.

1.3 Report Structure

The National Planning Policy Framework (NPPF) and the Flood Risk and Coastal Planning Practice Guidance (PPG) are the current guidance on development and flood risk in England and Wales. The Flood Risk technical guidance for the National Planning Policy Framework requires a Flood Risk Assessment (FRA) to be carried out on sites over 1ha to consider all potential forms of flooding including that from river, sea, estuarial, land drainage, groundwater, overland flow, surface water run-off, sewer systems, and artificial water bodies (lakes, reservoirs, canals etc.) to both the development site and offsite parties and land.

1.4 This report will take the structure of a 'Flood Risk Assessment' in accordance with the NPPF (2023), the FRC PPG (2014), the Environment Agency's Flood Risk Assessment Guidance and CIRIA Report 624 'Development and Flood Risk.

1.5 The objectives of this report are:

- To confirm whether the proposed development site is affected by current or anticipated future flooding from all sources for the lifetime of the site.
- To confirm that this development will not increase the risk of flooding to any offsite properties and land or increase the population within a floodplain.
- To undertake calculations to establish the foul and surface water runoff rates from the existing site and to assess the potential foul and surface water runoff from the proposed development.
- To detail a suitable strategy for the management of foul and surface water generated from the proposed development allowing for future climate change.
- To satisfy the approving planning authority that the most sustainable foul and surface water drainage solutions have been considered, in line with Environment Agency guidance, The Building Regulations (Document H 2002) and government legislation such as the Flood and Water Management Act 2010 (Defra) and The National Planning Policy Framework (NPPF 2023 & FRC PPG 2014) and the local surface water management plan.

2 The Development Site

Figure 1: Site location Image courtesy of: Bing Maps, 2024 Microsoft Corporation Image courtesy of Ordnance Survey

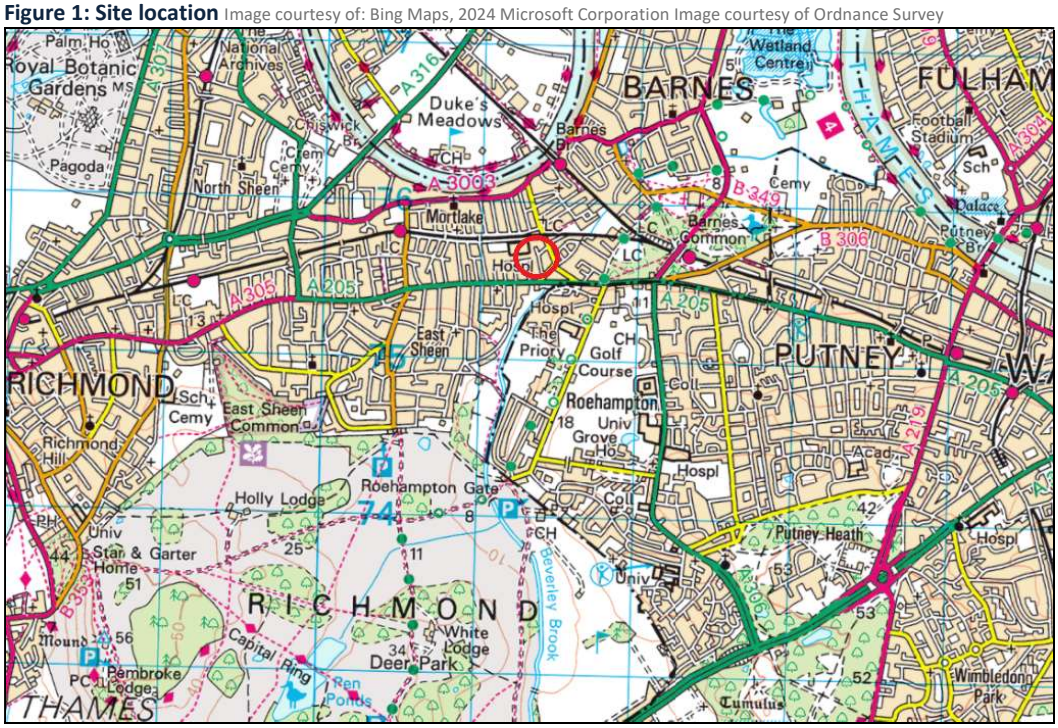


Figure 2: Development boundary Image courtesy of: Google Maps, 2024 Microsoft Corporation

2.1 Site Location and Description

The application site is located at land formerly associated with Grosvenor Garage, a vehicle workshop located to the west of Fitzgerald Avenue in East Sheen.

2.2 The 940m² (0.094 ha) parcel of brownfield land comprises garages buildings, workshops and offices, with hardstanding surfacing to the remainder of the site.
The site is centred on National Grid Reference TQ 21320 75628.

2.3 Topography

A topographical survey of the site undertaken by Survey Design Services Ltd (May 2023) indicates the site is predominantly flat with a slight fall eastwards and levels ranging from 6.25 to 5.90mAOD.

2.4 Geology

At the time of writing, no intrusive site investigations have been carried out within the site. The following information has been obtained from desktop data where applicable.

2.5 It is recommended that intrusive investigations are undertaken within the site to confirm the underlying geology, soil permeability and groundwater levels for the detailed design of the proposed surface water drainage system.

2.6 Due to the existing developed nature of the site a layer of made ground will be present. Information published by the British Geological Survey (BGS), indicates that the site is anticipated to be directly underlain by the Kempton Park Gravel Member (sand and gravel) overlying a bedrock of the London Clay Formation (clay).

2.7 With reference to local BGS borehole records (TQ27NW12 & TQ27NW11) the thickness of the Kempton Gravel Member extends to approximately 5-7mBGL overlying the London Clay geology.

2.8 Due to the historical land use of the site, there is potential for ground contamination in the form of hydrocarbons and oils.

2.9 Soil Permeability

Soil infiltration testing has not been carried out at this site to date.
With reference to the BGS data, the underlying geology at the site is the Kempton Park Gravel Member to approximately 7mBGL overlain the London Clay Formation.
It would be generally expected for sand and gravel soils to be relatively free draining and exhibit good permeability characteristics, although the potential for clay and silt content within these river terrace deposits can reduce permeability.
The soils of the London Clay Formation are highly impermeable.

2.10 Groundwater

Groundwater monitoring has not been carried out at the site to date.
Groundwater levels in this area of London are anticipated to vary between approximately 2-5mBGL and can be highly dependent on seasonal conditions.

2.11 Due to the proximity of the site to the River Thames, it would be expected for the groundwater table beneath the site to be in hydraulic connectivity with the river within the river terrace deposits.

2.12 Whilst the risk of groundwater flooding from underground aquifers is very low, due to the presence of made ground and the underlying geology, there is the potential for 'perched' groundwater to be encountered.
These local pockets of groundwater can be confined within the upper layer of head deposits by the underlying impermeable clay soils.

2.13 Investigations will be carried out during the intrusive geological site survey to ascertain exact groundwater levels across the site and to confirm the presence of any perched groundwater.

2.14 The consideration of encountering groundwater during the construction of the development and the vulnerability of the site and proposed SuDS to high groundwater levels is to be considered during detailed design.
The base of any infiltrating SuDS structures are to be at least 1m above the maximum groundwater level or be lined to prevent interaction with any underlying groundwater.

2.15 Hydrogeology, Hydrology and Existing Site Drainage Characteristics

The Environment Agency has classified the site as not located within a Groundwater Source Protection Zone.

2.16 The superficial deposits of the Kempton Park Gravel Member are classified as a 'Secondary A' aquifer.
These are layers of rock that are capable of supporting water supplies at a local rather than strategic scale, and in some cases are part of an important source of base flow to rivers.

2.17 The bedrock of the London Clay Formation is classified as 'Non-productive'.

2.18 The existing site is 100% impermeable with surface water runoff from roofs and hardstanding areas drained via a dedicated private on-site drainage system with an un-attenuated discharge into the existing Thames Water storm sewer network within Fitzgerlad Avenue and Grosvenor Avenue to the east and west of the site respectively.
No soakaways have been identified within the site.

2.19 All foul water flows generated from the existing site discharge into the existing Thames Water foul sewer network within Fitzgerald Avenue to the east of the site.

2.20 The nearest watercourse to the site is an unnamed culverted 'main river' which flows 100m beyond the eastern boundary of the site running northwards beneath White Hart Lane.
This culvert continues in a northerly direction where it outfalls into the River Thames.

2.21 The site is within the immediate hydrological catchment of the Beverley Brook an open 'main river' that flows 200m beyond the southeast of the site and continues in an easterly direction to its confluence with the River Thames.

2.22 The River Thames is located 500m north of the site at its closest point.
This section of the Thames through the borough is tidally influenced downstream of Teddington Lock.

3 Flood Risk Assessment

3.1 The assessment of flood risk to the site requires that all potential forms of flooding be considered.
In accordance with the Environment Agency's Flood Risk Assessment Guidance, NPPF, PPG and CIRIA Report 624, sources of flooding to be assessed include tidal, fluvial (rivers, streams and watercourses), pluvial (overland rainfall runoff), groundwater, artificial sources (canals and reservoirs) and existing/proposed sewerage and water mains infrastructure.

3.2 In relation to the proposed development site, there is an established body of policy and guidance documents which are of particular importance when considering development and flood risk.

National Legislative and Policy Documents

- Flood Risk Regulations (2009)
- Flood and Water Management Act (2010)
- Flood Risk and Coastal Change Planning Practice Guidance (2014)
- National Planning Policy Framework (NPPF) (2023)

Regional Flood Risk Policy

- London Plan 2021
- Thames Catchment Flood Management Plan 2009
- Thames River Basin Flood Risk Management Plan 2016
- London Sustainable Drainage Action Plan (2016)

Local Documents and Strategies

- Richmond upon Thames Local Plan (2018)
- Local Flood Risk Management Strategy (LFRMS)
- Preliminary Flood Risk Assessment (PFRA) (2011)
- Surface Water Management Plan (2011)
- Strategic Flood Risk Assessment (SFRA) (2021)

3.3 History of Flooding

During the data collection process, it is important to consider the information which already exists for the site location with respect to flood risk. The main sources of data for flood risk and recorded incidents of flooding for this site have been the London Borough of Richmond PFRA (2011) and SFRA (2021) reports.
Additional information has been obtained from The Environment Agency, Thames Water, the British Society Chronology of Extreme Hydrological Events, local news and media outlets.

3.4 With reference to the above, and in the context of the proposed development, there are no historic issues of flooding from the following potential sources including:

- Fluvial (Rivers and Sea).
- Tidal.
- Groundwater.
- Pluvial (Surface water runoff).
- Existing foul, storm and combined sewers or potable water main infrastructure.
- Artificial infrastructure.

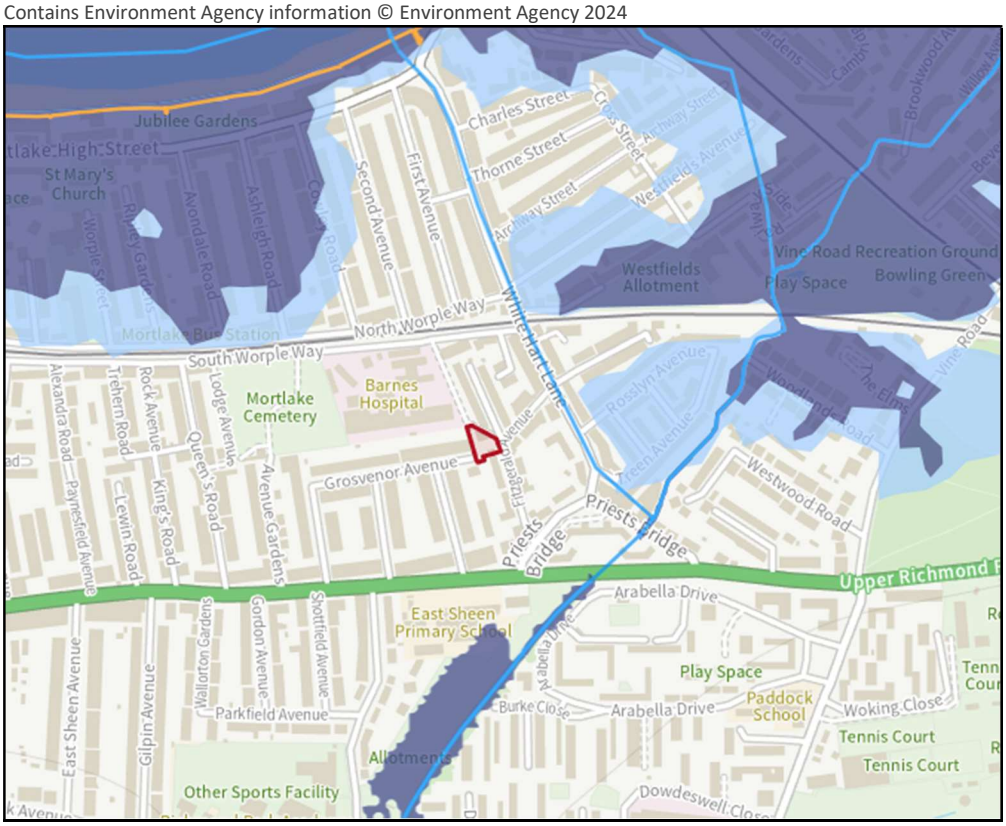
3.5 Fluvial

The nearest source of fluvial flood risk to the site is from the River Thames and its tributary the Beverley Brook which are located 500m north and 200m southeast of the site respectively. Both of these main rivers benefit from flood defences.

3.6 The Environment Agency is the principal flood risk management operating authority in England. The EA has carried out a national flood risk assessment (NaFRA) which assesses the probability of flooding to land from all main rivers in England.
The results of this modelling are combined and calibrated against data from recorded flood events to produce the Environment Agency's Flood Zone Map (Figure 3).
The EA's Flood Zones are based on the undefended flood scenario and do not account for the 'actual' flood risk in an area that benefits from flood defence assets.

Figure 3: Extract from Environment Agency River and Sea Water Flood Map (February 2024)

Contains Environment Agency information © Environment Agency 2024



Key:

Main Rivers

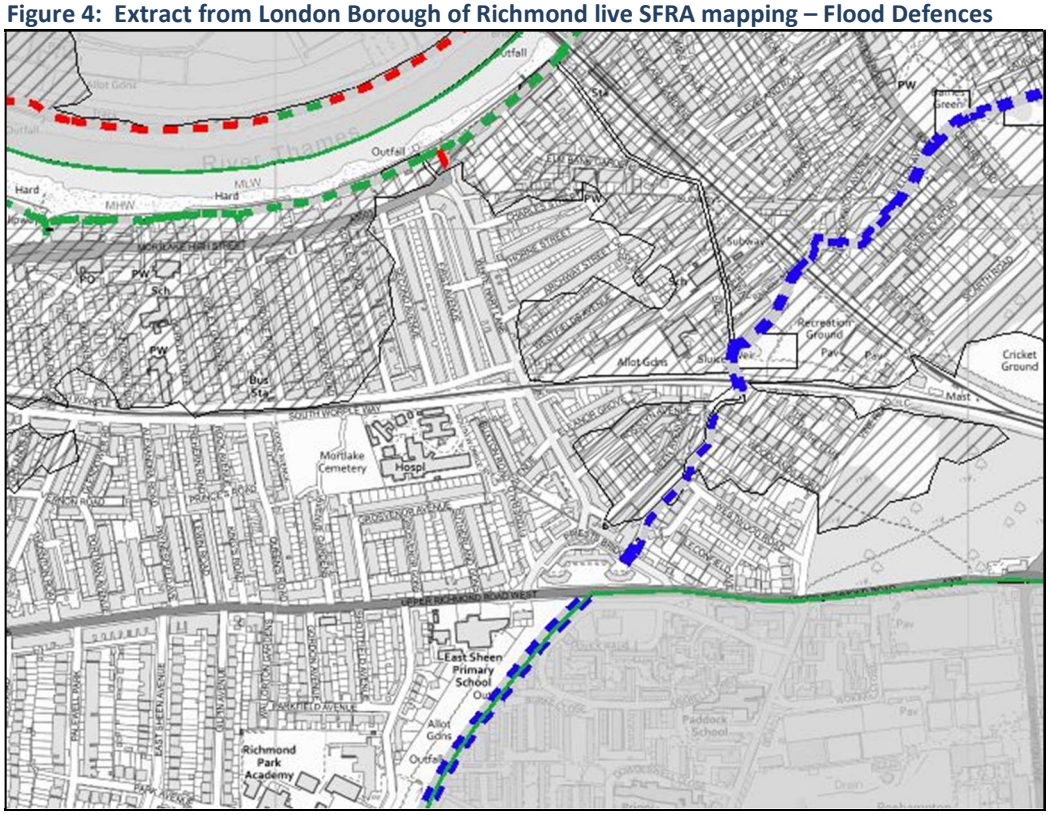
Dark Blue : (Flood Zone 3)
Shows the area that could be affected by flooding, either from rivers or the sea, if there were no flood defences. This area could be flooded: from the sea by a flood that has a 0.5% (1 in 200) or greater chance of happening each year, or from a river by a flood that has a 1% (1 in 100) or greater chance of happening each year.

Light Blue : (Flood Zone 2)
Shows the additional extent of an extreme flood from rivers or the sea.
These outlying areas are likely to be affected by a major flood, with up to a 0.1% (1 in 1000) chance of occurring each year.
These two colours show the extent of the natural floodplain if there were no flood defences or certain other manmade structures and channel improvements.

Clear : (Flood Zone 1)
Shows the area where flooding from rivers and the sea is very unlikely.
There is less than a 0.1% (1 in 1000) chance of flooding occurring each year.

3.7 The latest Environment Agency 'Flood Zone Map' (February 2024) indicates the site is located within the lowest risk category - Flood Zone 1. 'Flood Zone 1' is land assessed as having a less than 1 in 1000 (<0.1%) annual probability of flooding from a main river in each year and is not within an area of recorded river flooding.

Figure 4: Extract from London Borough of Richmond live SFRA mapping – Flood Defences



3.8 The above Figure 4 demonstrates the reduction in floodplain due to the current flood defences.

3.9 Richmond Borough as the Lead Local Flood Authority (LLFA) is responsible for assessing the flood risk from all other ordinary watercourses (non-main rivers) in the area, with this information detailed in the PFRA/SFRA reports.

3.10 These studies have concluded that there have been no recorded incidents of flooding from this watercourse and that the site is not at risk of flooding from all ordinary watercourses within the locality of the development.

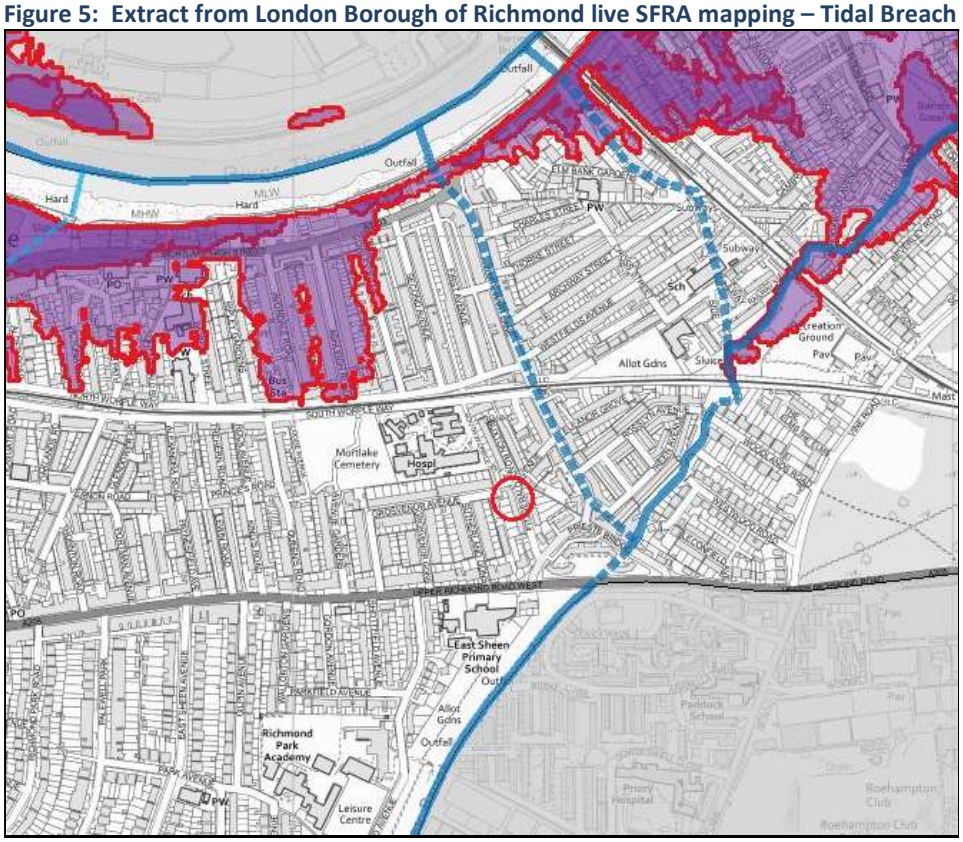
3.11 It is demonstrated that safe and dry access and egress at the site is achievable to a publicly accessible location outside the 1:100 year (plus climate change) flood event extent, in accordance with DEFRA Report FD2320/TR2 - 'Flood Risk Assessment Guidance for New Developments'. All site entrances provide a safe egress.

3.12 Tidal

Within Richmond Borough, the River Thames is tidally influenced up to Teddington Weir. The Thames Tidal Defences however protect the borough from tidal flooding through a combination of raised defences and the Thames Barrier.

3.13 Assessments of tidal flood risk should use the current Environment Agency TE2100 crest levels guidance and breach modelling accounting for the worst-case scenario.
The closest TE2100 Extreme Water Level node to the site indicates a level of 5.17mAOD (Modelled) and results in the tidal breech inundation map shown in figure 5.

Figure 5: Extract from London Borough of Richmond live SFRA mapping – Tidal Breach Inundation



3.14 Surface Water

The Environment Agency's 'uFMfSW' (updated Flood Map for Surface Water) (Figure 6) is a theoretical assessment of potential overland flow paths, ground levels and drainage systems using information from the London Borough of Richmond as the LLFA to indicate areas that may be susceptible to surface water flooding.

Figure 6: Extract from Environment Agency Surface Water Flood Map (February 2024)

Key:

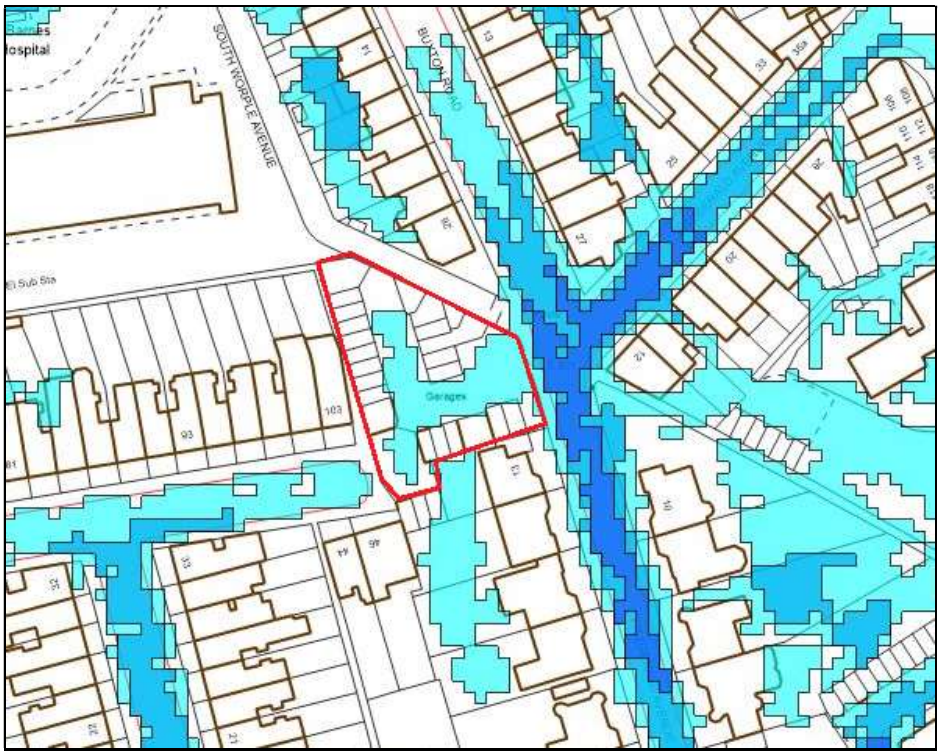
- High (Greater than 1:30(3.3%) chance of flooding)
- Medium (Between 1:100(1%) and 1:30(3.3%) chance of flooding)
- Low (Between 1:1000 (0.1%) and 1:100 (1%) chance of flooding)
- Very Low (Less than 1:1000 (0.1%) chance of flooding)

3.15 The latest mapping indicates that the existing site has a low risk (Between 1:1000 to 1:100 or 0.1% to 1% AEP) of surface water flooding.

3.16 Due to current ground levels with the site being higher than Fitzgerald Avenue, it is expected that this risk of surface water flooding is attributed to runoff generated from the site itself rather than from an offsite flow path.

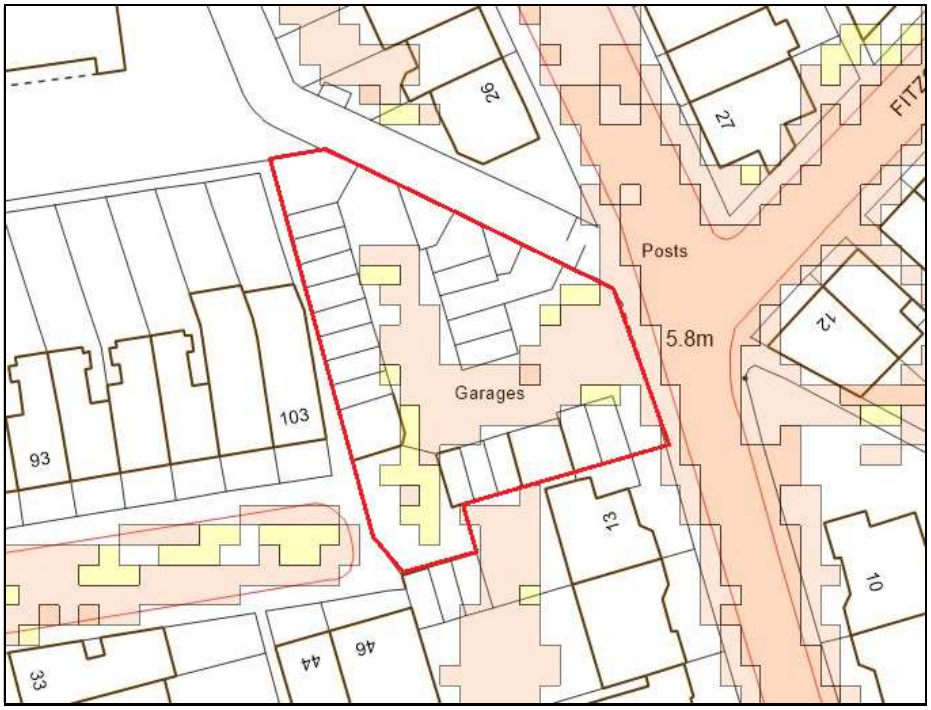
3.17 During intense or prolonged rainfall events the drainage infrastructure serving the site may be overwhelmed resulting in above-ground flooding and overland runoff onto Fitzgerald Avenue.

Figure 7: Extract from London Borough of Richmond live SFRA mapping – SW Flood Extent



3.18 Figure 7 from the London Borough of Richmond SFRA indicates the site has a 1:1000 (0.1%AEP) annual chance of flooding from surface water.

Figure 8: Extract from London Borough of Richmond live SFRA mapping – SW Flood Depth



3.19 Figure 8 from the London Borough of Richmond SFRA indicates the maximum depth of flooding within the existing site could reach up to 300mm in depth.

3.20 The development of this site will fundamentally alter the existing brownfield runoff regime, via the reduction in overall permeable surfacing and the implementation of a robust SuDS scheme to manage surface water runoff to current design standards.

3.21 This will provide a level of betterment over existing conditions by ensuring all runoff from impermeable areas at the site is attenuated and released at a controlled rate, preventing onsite flooding and uncontrolled runoff onto Fitzgerald Avenue.

3.22 Notwithstanding the proposed alterations to the site layout and construction of a new drainage system, to mitigate the risk of surface water flooding no basement or cellar levels are proposed.

3.23 Groundwater

With reference to the London Borough of Richmond SFRA, the site is located within an area classed as at 75% risk of groundwater flooding.

3.24 The PFRA, SFRA and the Environment Agency confirm that no recorded events of groundwater flooding have been identified at or within the vicinity of the site.

3.25 Under the development proposals, no basement or cellar levels are proposed.

3.26 It is acknowledged that due to the proximity of the site to the River Thames, groundwater levels beneath the site could be elevated by and in hydraulic continuity with the river via the underlying river terrace deposits.
Therefore, the site is at moderate risk of groundwater flooding during normal conditions, however, this risk increases when the River Thames is in flood.

3.27 As these sources of flooding are inextricably linked with the reach of the Thames floodplain, the proposed mitigation methods and flood management plan for this development are relevant to both groundwater and fluvial flooding.

3.28 As this redevelopment will not involve the creation of deep foundations or basement levels, the proposals will not affect the site-wide and offsite groundwater flow regime and overall flood risk from groundwater.

3.29 Artificial Sources

With reference to the SFRA/PRFA there have been no recorded incidents of flooding to the site or surrounding areas from artificial sources.

3.30 There are no additional artificial sources of flooding, such as that from canals, reservoirs and sewage treatment works within a 1 km radius of the site.

3.31 Overland Flood Flow / Exceedance

The occurrence of overland flooding at the site due to an extreme rainfall event exceeding the design capacity of the drainage system and SuDS, or a failure of the associated flow controls have been considered both during the construction and operational phase of the development.

3.32 If SuDS or the piped drainage system becomes overwhelmed by exceptional rainfall then exceedance routes are proposed to protect people and property by providing unobstructed overland flow routes across the development.

3.33 The design levels of hard paved and landscaped areas will aim to contain and convey flood flows through areas of the site to cause minimum flood risk to properties and residents such as parking areas and low-lying open space.

3.34 All proposed attenuation features within the development are designed to manage the 1 in 100 year return storm (1% chance of occurrence each year) plus an extra allowance of 45% for the potential increase in peak rainfall predicted up to 2115.

3.35 The drainage network will be designed with a factor of safety to account for urban creep. An additional 10% will be added to all impermeable areas where appropriate.

3.36 The described protection measures ensure that properties both within the proposed development and any offsite parties and land will not be affected by overland runoff in the event of a reasonably extreme rainfall event exceeding the design storm or a failure or a blockage of the SuDS structures within the system.

3.37 Existing Sewers & Water Mains

With reference to SFRA, the site is located within an area with 0-10 recorded incidents of sewer flooding.
The Thames Water DG5 register does not record any specific indication of sewer flooding within the immediate vicinity of the site.

3.38 Thames Water will be consulted to confirm that there is adequate capacity for the proposed development surface and foul flows with the local public sewerage system.
If required, reinforcement of the sewer networks will be undertaken by Thames Water to ensure that the proposed development will have a 'no detriment' impact and does not create an increase in flood risk.

3.39 Proposed Site Drainage

A Flood Risk Assessment requires that an evaluation of all proposed artificial drainage systems and infrastructure within, or in close proximity to the site is carried out. In the context of this development, the following systems are to be installed which need to be assessed in terms of potential flooding through the capacity of the systems being exceeded or the structural, hydraulic, mechanical or operational failure of the system occurring during the lifetime of the development:

- Piped foul water sewers, manholes and potable water mains.
- SuDS for the temporary conveyance and attenuation of surface water.

3.40 All adoptable foul and surface water drains, sewers and manholes will be designed and constructed to the DCG (2021) with all private drainage constructed in accordance with *The Building Regulations Part H, BS EN 752 or BS EN 12056-2* as appropriate, ensuring adequate design capacity and robust structural integrity for the lifetime of the development.

3.41 This will not only prevent the risk of flooding to both the development and offsite parties but will avoid the potential contamination of groundwater by preventing the ingress of groundwater into the pipework and egress of sewage into the underlying soils.

3.42 All SuDS within the drainage system will be sized to manage the runoff from the exceptionally rare 1 in 100 storm event (1% AEP), plus an additional 40% allowance for predicted future climate change effects (in accordance with EA recommendations up to the year 2115).

3.43 The new development as a whole must not create or exacerbate existing flood risk elsewhere and in particular to properties, land and highways downstream of the site. During the design of the proposed development careful consideration has been given to the most sustainable method of surface water disposal and strict controls have been imposed to limit the peak rate and volume of runoff generated from the developed site.

3.44 All surface water runoff from impermeable areas on the proposed development will be attenuated and safely disposed of at a controlled rate to replicate the existing brownfield runoff regime for the site. This will ensure that the risk of flooding to properties and land downstream of the site will not increase as a result of this proposed development.

3.45 Planning Policy

In accordance with the Flood Risk and Coastal Planning Practice Guidance (PPG); *Table 3 - Flood risk vulnerability and flood zone 'compatibility'*; (Figure 4) development classed as 'more vulnerable' is considered appropriate within Flood Zone 1.

Figure 5 - DGLC Flood risk and coastal change Table 3: flood risk vulnerability and flood zone 'compatibility' DGLC Flood risk and coastal change

Flood Zones	Flood Risk Vulnerability Classification				
	Essential infrastructure	Highly vulnerable	More vulnerable	Less vulnerable	Water compatible
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	Exception Test required	✓	✓	✓
Zone 3a †	Exception Test required †	✗	Exception Test required	✓	✓
Zone 3b *	Exception Test required *	✗	✗	✗	✓*

Key:

✓ Development is appropriate

✗ Development should not be permitted.

3.46 Sequential Test

The flood risk technical guidance to the National Planning Policy Framework (NPPF) categorises residential developments as 'More Vulnerable' within the risk classification. 'More vulnerable' developments located within Flood Zone 1 are considered appropriate under the NPPF.

3.47 The NPPF guidance states that planning authorities should complete a risk-based 'Sequential Test' at all stages of the planning process, to steer new development to areas with the lowest probability of flooding. Under the requirements of the 'Sequential Test' and as the proposed development is already located within Flood Zone 1 (lowest risk), there are no more suitable, developable and deliverable alternative sites, better located from a flood risk perspective which could accommodate the proposed development.

5 Existing and Proposed Site Runoff

5.1 This section calculates the peak rate and volume of surface water runoff from the existing site. These discharge figures are then used to establish the post-development constraints to inform the preliminary design of the site surface water drainage strategy.

5.2 Catchment Areas

The existing and proposed permeable and impermeable areas are listed in the table below. The current site of 940m2 is 100% impermeable and served by a dedicated surface water system that currently discharges unattenuated into the Thames water storm network.

Site Catchment	Impermeable	Permeable	Total
Existing Site Area	940 m²	0 m²	**940** m²
Proposed Site Area	750m*²	190m²	**940** m²

5.3 This development represents an overall reduction of 190m²* in impermeable area post-development.
*In accordance with best practice, an allowance of 10% for urban creep has been applied to private areas to account for the potential increase in impermeable surfacing over the lifetime of the development.
This results in a total potential impermeable area of **770m2** as a result of this development.

5.4 Existing Surface Water Runoff Peak Runoff Rate & Volume (Brownfield)

An appropriate method of establishing the peak runoff rates from the existing brownfield site is via the Modified Rational Method 'Q=2.78 Cv Ci I A':

Where:
Q = Peak discharge (l/s)
Cv = Rational method runoff coefficient (roof/hardstanding use 0.84)
Cr = Routing Coefficient (use 1.3)
I = Average Rainfall Intensity, (mm/hr) (equal to time of concentration for site, use 15mins)
A = Contributing area (0.094ha)

Return Period (year)	Duration (mins)	Ave.I (mm/hr)
1	15	32
30	15	78
100	15	101
100	360	10.1

(0.094ha Existing catchment)

1 Year	9.1 l/s
30 Year	22.6 l/s
100 Year	28.8 l/s
Volume 100y 6hr	60.0 m³

5.5 Existing Surface Water Runoff Peak Runoff Rate & Volume (Greenfield)

An assessment of the estimated current greenfield runoff rate has been carried out using the Institute of Hydrology Report 124 (QBar) methodology.

Catchment: 0.094ha (FSR)

1 in 1 year	0.1 l/s
QBAR	0.1 l/s
1 in 30 year	0.3 l/s
1 in 100 year	0.5 l/s

5.6 Post Development Surface Water Runoff Peak Runoff Rate & Volume

The procedure for surface water management in accordance with 'Rainfall runoff management for developments' (DEFRA/EA Report – SC030219 E, 2013) and the 'Non-statutory technical standard for sustainable drainage systems' (DEFRA, 2015) are set out below.
In the case of brownfields sites, drainage proposals will be measured against the existing performance of the site.

5.7 Peak Flow

For brownfield developments, the peak runoff rate from the redevelopment to any drain, sewer or surface water body up to the 1 in 100 year rainfall event including an appropriate allowance for climate change, must be no greater than the existing runoff rate.

5.8 Volume Control

For brownfield developments, the runoff of volume from the development to any highway drain, sewer or surface water body in the 1 in 100 year, 6 hour rainfall event including an appropriate event, must be no greater than the existing pre-developed greenfield volume. Where it is not reasonably practicable to constrain the volume of runoff (i.e. via infiltration) the runoff volume must be discharged at a rate that does not adversely affect flood risk (i.e. QBar / 2.3year runoff).

5.9 The National Planning Policy Framework requires that consideration be given to the effect of climate change on the surface water flows generated by any new development.
DEFRA specifies that within the London Management Catchment, an assessment of a 40% increase in rainfall intensity allowance is made when calculating post-development runoff rates for the site with a design lifespan of approximately 100 years.

5.10 In addition to the national surface water management guidance, Policy LP 21 of the adopted Richmond Borough local plan (2018) states:
Applicants will have to demonstrate that their proposal complies with the following:

- A reduction in surface water discharge to greenfield run-off rates wherever feasible.
- Where greenfield run-off rates are not feasible, this will need to be demonstrated by the applicant, and in such instances, the minimum requirement is to achieve at least a 50% attenuation of the site's surface water runoff at peak times based on the levels existing prior to the development.

5.11 As a result of this development there is an overall reduction in impermeable areas. However, when considering the potential effects of climate change over the lifetime of the development, the peak rate and volume of surface water that could potentially runoff the proposed site if not effectively managed, could be greater than in its current state.

5.12 To mitigate this increase, it is proposed that all surface water runoff from impermeable areas at the proposed development for up to the 1:100year +40%cc rainfall event will be attenuated on-site via the use of sustainable drainage systems (SuDS) with an offsite discharge restricted to a maximum of the existing brownfield runoff rate with a minimum 50% reduction for the frequent rainfall events up to a reduction of over 80% for the extreme rainfall evens.

5.13 To restrict runoff from the redevelopment to the current greenfield runoff rate of 0.1 l/s would result in excessively large onsite attenuation and require extremely small flow control orifices, increasing the risk of long-term maintenance issues and blockages.

Existing and proposed peak runoff from the site

EVENT	EXISTING	PROPOSED	% REDUCTION
1 in 1 year	9.1 l/s	4.5 l/s	50%
1 in 30 year	22.6 l/s	4.5 l/s	80 %
1 in 100 year	28.8 l/s	4.5 l/s	84 %

5.14 This demonstrates that a significant level of betterment over existing conditions can be achieved by reducing the peak rate of surface water entering the downstream public sewer system.
This offers a sustainable, safe and robust surface water management strategy which ensures that the development will not increase the level of flood risk to offsite properties and for the lifetime of the site and reduces the burden on the downstream drainage network.
The proposed discharge rates comply with the policies outlined in the London Plan (2021), the Richmond upon Thames Local Plan (2018) and the NPPF (2023).

6 Surface Water Drainage Strategy

6.1 The National Planning Policy Framework (NPPF) requires that developments do not exacerbate flood risks both to the development site and to offsite parties and land, which means there is a need to control surface water drainage and overland runoff to ensure there are no increases in peak rates and volumes of runoff as a result of the development.

6.2 Environment Agency guidance and government legislation such as the Flood and Water Management Act (Defra 2010) require surface water drainage strategies for new developments to be in accordance with the ideals of 'sustainable development' via the provision of Sustainable Drainage Systems (SuDS).

6.3 SuDS are more sustainable than conventional drainage methods because they can mitigate many of the adverse effects of urban stormwater runoff on the environment. This can be achieved through reducing peak runoff rates and volumes to sewer networks and watercourses, reducing the risk of downstream flooding.

6.4 The Building Regulations Document H (2015), The SuDS Manual CIRIA 753 (2015) and Policy SI13 'Sustainable Drainage' of the London Plan (2021) detail the appropriate hierarchy of potential methods for disposing of surface water:

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

6.5 Infiltration testing in accordance with BRE365, groundwater monitoring and contamination assessment will be required to confirm the use of infiltration SuDS within the site. Spatial constraints may restrict the use of infiltration SUDS to limited locations within the development so as to provide the required 5m offset in accordance with Building Regulations.

6.6 In the absence of this data, it is proposed that all runoff from proposed impermeable areas be attenuated within the site via the use of SuDS, with a positive outfall into the existing Thames water storm sewer network, replicating the current surface water management for the site.

6.7 The use of Green Roofs, Rainwater Harvesting, Water Butts and other features such as Rain Garden Planter Boxes connected to RWP's are to be promoted where feasible to accompany the principal site attenuation before disposal offsite.

6.8 Whilst the use of 'Green Roofs' is encouraged where feasible, there are architectural, structural, ecological and landscape issues to be considered. An assessment of the areas of roof that could be utilised and the detailed design of such features by a specialist is recommended.

6.9 The peak rate of runoff from the development will be restricted to the existing 1 year brownfield runoff rate with an additional 50% reduction (4.5 l/s) for up to the 1:100 year +40% climate change rainfall event.

6.10 All SuDS will be sized to manage the runoff from the 1 in 100 rainfall event (1% AEP), plus an additional 40% allowance for predicted future effects of climate change (in accordance with EA recommendations up to the year 2115).

6.11 The proposed surface water drainage strategy offers a sustainable, safe and robust system which will afford complete flood risk protection to the occupants of the proposed dwellings and the existing properties and land within the vicinity of the site.
This strategy replicates the existing drainage regime for the brownfield site and ensures that the peak rate and volume of surface water runoff will be no greater than the existing greenfield runoff rate for the site for all rainfall events up to the 100 year +40% rainfall event.
The development of this site will offer a minimum 50% reduction in peak runoff for the frequent rainfall events and up to a reduction of over 80% for the extreme rainfall events, reducing the burden of the downstream public sewer network.

6.12 Attenuation Requirements

For the proposed impermeable area of 770m2, the required volume of attenuation to store the 1:100y+40% rainfall event, discharging at a rate of 4.5 l/s is approximately 32m³.

6.13 Proposed SuDS Overview

The SuDS selection process for this site has involved the evaluation of a range of information to enable the feasibility of each SuDS technique to be assessed.
From this information, a suitable drainage strategy has been developed.

6.14 It is proposed that a combination of permeable surfacing with a stone sub-base and below-ground cellular attenuation will form the primary surface water management technique for this redevelopment.

Table 1: SuDS Feasibility Matrix

SuDS Type	Description	Suitable for this site	Comments
Green/Blue Roofs	Green roofs comprise a multi-layered system that covers the roof of a building with vegetation cover over a drainage layer. They are designed to intercept and retain rainfall, reducing the volume of runoff and attenuating peak flows.	✓	Living Roofs and podium deck (blue roofs) could be incorporated into this development where technically feasible subject to factors such as loadings, roof pitch, visual impact and maintenance burden.
Rainwater Harvesting	Re-using rainwater for non-potable purposes such as irrigation and toilet flushing.	✓	Rainwater harvesting techniques can be utilised for non-potable (greywater) re-use subject to factors such as spatial constraints, whole-life costs and maintenance burden. The watering of landscaped areas by connecting RWP's to planters can easily be achieved at this site to reduce potable water demand at the development.
Soakaways	Soakaways provide stormwater attenuation, stormwater treatment and groundwater recharge.	✓ ✗	Subject to BRE365 infiltration testing and groundwater level confirmation. Spatial constraints may limt use across the site to achieve 5m offset
Filter Strip / Trenches / Swales	Filter strips are linear grassed or vegetated strips of land / channels designed to accept runoff as overland sheet flow from impermeable surfaces usually located adjacent road or parking areas and used to treat infiltrated or convey runoff.	✗	Limited space on urban site to incorporate swales.
Permeable Paving	Pervious pavements provide a pavement suitable for pedestrian and vehicular traffic, while allowing rainwater to infiltrate through the surface and into the underlying layers. The water is temporarily stored before infiltration to the ground, reuse, or discharge to a watercourse or other drainage system.	✓ non-infiltrating	Permeable surfacing with a tanked (non-infiltration) sub-base connected to a positive drainage system would be suitable for this development. Testing to confirm use as infiltration feature.
Bio Retention	Bioretention areas are shallow landscaped depressions which are typically under-drained and rely on engineered soils and enhanced vegetation and filtration to remove pollution and reduce runoff downstream. They are aimed at managing and treating runoff from frequent rainfall events.	✗	No green open space to incorporate on this development.
Ponds / Basins	Ponds can be used to store and treat water. 'Wet' ponds have a constant body of water and run-off is additional, while 'dry' ponds are empty during periods without rainfall. Ponds can be designed to allow infiltration into the ground or to store water for a period of time before discharge.	✗	No green open space to incorporate on this development.
Underground Storage	Underground Concrete or Geocellular Tanks to reduce and attenuate peak flows	✓	The use of underground storage to attenuate runoff would be suitable at this development.

6.15 Pollution Prevention and Groundwater Protection

It is important that the development of this site does not adversely affect the existing hydrological conditions and impact the quantity and quality of runoff from the site.
As such, all surface water runoff from impermeable areas at this development will receive an appropriate level of treatment to remove hydrocarbons and other contaminants prior to discharge from the site.

6.16 In terms of water quality, the proposed surface system offers a suitable level of mitigation in accordance with the Environment Agency pollution prevention guidance GP3, CIRIA C753 and DEFRA guidance.

6.17 The pollution hazard of surface water runoff from residential roofs is very low and the hazard of surface water runoff from residential car parks, and low-traffic roads (e.g. cul-de-sacs, home zones, general access roads) is low.

6.18 The CIRIA SuDS Manual 2015 details an approach for establishing the hazard posed by the intended land use activities and the extent to which the proposed SuDS components can reduce and mitigate the contamination risk to the receiving waterbody.

6.19 Referring to Table 26.2 – 'Pollution hazard indices for different land use classifications' the proposed development and land use results in a low pollution hazard, therefore a 'Simple Index' method can be used to make a qualitative assessment of the proposed SuDS management.

Table 2 - Table 26.2 – 'Pollution hazard indices for different land use classifications' CIRIA C753, 2015

TABLE 26.2 Pollution hazard indices for different land use classifications

Land use	Pollution hazard level	Total suspended solids (TSS)	Metals	Hydro-carbons
Residential roofs	Very low	0.2	0.2	0.05
Other roofs (typically commercial/ industrial roofs)	Low	0.3	0.2 (up to 0.8 where there is potential for metals to leach from the roof)	0.05
Individual property driveways, residential car parks, low traffic roads (eg cul de sacs, homezones and general access roads) and non-residential car parking with infrequent change (eg schools, offices) ie < 300 traffic movements/day	Low	0.5	0.4	0.4

6.20 To deliver adequate treatment, the selected SuDS components should have a total pollution mitigation index that equals or exceeds the pollution hazard index:

Total SuDS mitigation index ≥ pollution hazard index
For the development site: TSS = 0.5, Metals = 0.4, Hydrocarbons = 0.4

Table 3 - Table 26.3 – 'Indicative SuDS mitigation indices for discharges to surface waters' CIRIA C753, 2015

TABLE 26.3 Indicative SuDS mitigation indices for discharges to surface waters

	Mitigation indices[1]		
Type of SuDS component	**TSS**	**Metals**	**Hydrocarbons**
Filter strip	0.4	0.4	0.5
Filter drain	0.4[2]	0.4	0.4
Swale	0.5	0.6	0.6
Bioretention system	0.8	0.8	0.8
Permeable pavement	0.7	0.6	0.7
Detention basin	0.5	0.5	0.6
Pond[4]	0.7[3]	0.7	0.5
Wetland	0.8[3]	0.8	0.8
Proprietary treatment systems[5,6]	These must demonstrate that they can address each of the contaminant types to acceptable levels for frequent events up to approximately the 1 in 1 year return period event, for inflow concentrations relevant to the contributing drainage area.		

6.21 The proposed development surface water drainage system consists of the following SuDS components:

Primary Treatment – Permeable Paving
Using mitigation Indices:
TSS = 0.7 which is > 0.5 therefore ok.
Metals = 0.6 which is > 0.4 therefore ok.
Hydrocarbons = 0.7 which is > 0.4 therefore ok.

6.22 SuDS Management and Maintenance

It is envisaged that the maintenance liability of all private drainage infrastructure including permeable surfacing, flow controls and ancillary drainage components will be by a dedicated facilities management company in perpetuity, funded through an annual maintenance fee levied against the residents.
The developer will provide a SuDS maintenance and management plan to the management company, detailing the location of all SuDS components and the ongoing maintenance requirements to ensure the optimum operation of the surface water drainage network in perpetuity.

6.23 **Flow Control Chambers**
The vortex flow control units have no moving parts and are self-activating, requiring minimal maintenance.
The key maintenance requirement for the flow control chambers will be the inspection of the unit for blockages and the removal of silts and debris from the sump if required.

6.24 After initial installation, it is recommended that the unit be inspected monthly for three months.
Thereafter the inspection chamber and control device should be inspected at least every six months to verify the condition and operation of the unit and check for blockages within the inlet of the chamber and of the flow control device.
During these inspections, accumulated silts should be removed, and the sump cleaned out by hand.

6.25 Permeable Block Paving

Routine visual inspections

A major benefit of permeable paving is the ability to quickly and cost-effectively assess that it is working correctly. This can be done by visually inspecting the paving during heavy rainfall or following heavy rainfall.

In general, routine visual inspections are all that is required to determine whether or not remedial maintenance is required.

Any infiltration issues are shown up by water ponding on the surface of the paving.

If ponding is not visible then remedial action is not required.

In the unlikely event that individual blocks are damaged, these should be removed and replaced.

Note that any materials which may clog up the permeable joints such as soil and mulch should not be stored on top of the paving without protection.

Frequency: Once a year during or following heavy rainfall.

6.26 Remedial maintenance for ponding.

If surface water ponding is visible the joints should be manually brushed to remove moss, leaves, weeds or other debris and agitate the jointing material.

Brushing should be carried out in a manner which ensures that the paving blocks are not damaged and that jointing material is not completely removed from the joints.

Any jointing material which is removed must be replaced with 2-6mm grit in accordance with BSEN7533.

Weeds tend not to establish in areas which receive regular trafficking by vehicles. If weeds are an issue they can be dealt with by using a weed killer containing Glyphosate. The manufacturer's instructions should always be followed and adequate Health and safety measures should also be put in place when handling chemicals.

Frequency: As and when required.

6.27 Maintenance for aesthetics of the paving blocks.

Brushing with soapy water and a stiff brush will revive the colour of concrete block permeable paving. For a deeper clean of the block surface, a pressure washer can be used to maintain the appearance and colour of the paving blocks.

A pressure washer set to a light/medium pressure should be all that is required to remove general dirt and grime. High pressure should not be used as this can damage the surface of the blocks.

After cleaning is finished ensure that any jointing material which has been removed is topped up with the correct material (2-6mm grit).

6.28 Maintenance during the winter months.

Permeable Paving generally requires less de-icing than conventional concrete block paving. The controlled use of conventional road de-icing techniques can be used without affecting the overall performance of the paving. Some de-icing salts may leave temporary discolouration after the thaw. Normal weathering should soon remove this discolouration from the paving. De-icing salts should be applied before snow or ice develops as this helps protect the concrete surface. It is unlikely that the levels of chloride in the ground will increase significantly by employing conventional de-icing techniques.

Frequency: As required during winter

6.29 Structural Maintenance.

If a visual inspection has indicated that individual blocks have been damaged these blocks should be removed and replaced with new blocks. If rutting of the surface has occurred the area needs to be lifted and reinstated immediately as it may be a hazard to users.

Any blocks which are removed need to be reinstated correctly ensuring that the correct sub-base, bedding and jointing aggregates are used.

The installation method should be in accordance with BS 7533 Part 3. In particular, the joints should be filled to the top to ensure structural integrity.

Any geotextiles or membranes which are damaged during the reinstating process should be replaced. If the blocks are not damaged they can be lifted, cleaned and re-used.

Frequency: As required

SCHEDULE	ACTION	FREQUENCY
Routine visual inspection	Visually inspect the paving for ponding during heavy rainfall or following heavy rainfall.	Once a year
Remedial maintenance for ponding	Brush / vacuum joints Replace any lost jointing material	As required
Structural Maintenance	Replace damaged blocks Repair any rutting	As required
Maintenance for aesthetics of the joints	Brush / vacuum joints as required Replace any lost jointing material	Recommended once a year
Maintenance for aesthetics of the paving blocks	Brush with soapy water Light pressure wash	As required
Weed control	Treat with weedkiller	As required
Maintenance during the winter months	De-icing salts	As required during winter
WARNING!	Do not replace the jointing grit with kiln dried sand as this will block the joints and prevent infiltration. Do not store materials which may clog up the permeable joints such as soil and mulch on top of the paving.	

7 Foul Water Drainage Strategy

7.1 Foul water flows from the development will discharge via a new gravity pipe system, connecting into the existing Thames Water public foul sewer network within Fitzgerald Avenue and Grosvenor Avenue beyond the eastern and western boundary of the site respectively.

7.2 Thames Water will be consulted to establish whether there is capacity within the existing network and to carry out any necessary sewer upgrading works to accommodate the proposed foul flows from the development.
This will be funded by infrastructure charges levied on the developer per proposed plot on the development.
This will ensure that the proposed development has a 'no detriment' impact on the Local foul sewer system and does not create a flood risk.

APPENDIX A
SITE LAYOUT

1 Site Plan Proposed

- Residential (houses)
- Residential (apartments)
- Commercial
- Bins and cycle storage
- Greenery

N

0 1 2 3 4 5 10 15 20m
Scale 1:200

Rev.	Date	Detail
B	13.02.2024	
A	12.02.2024	

Status: Draft Issue

HALO ARCHITECTS

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Client: Hestia Homes Ltd

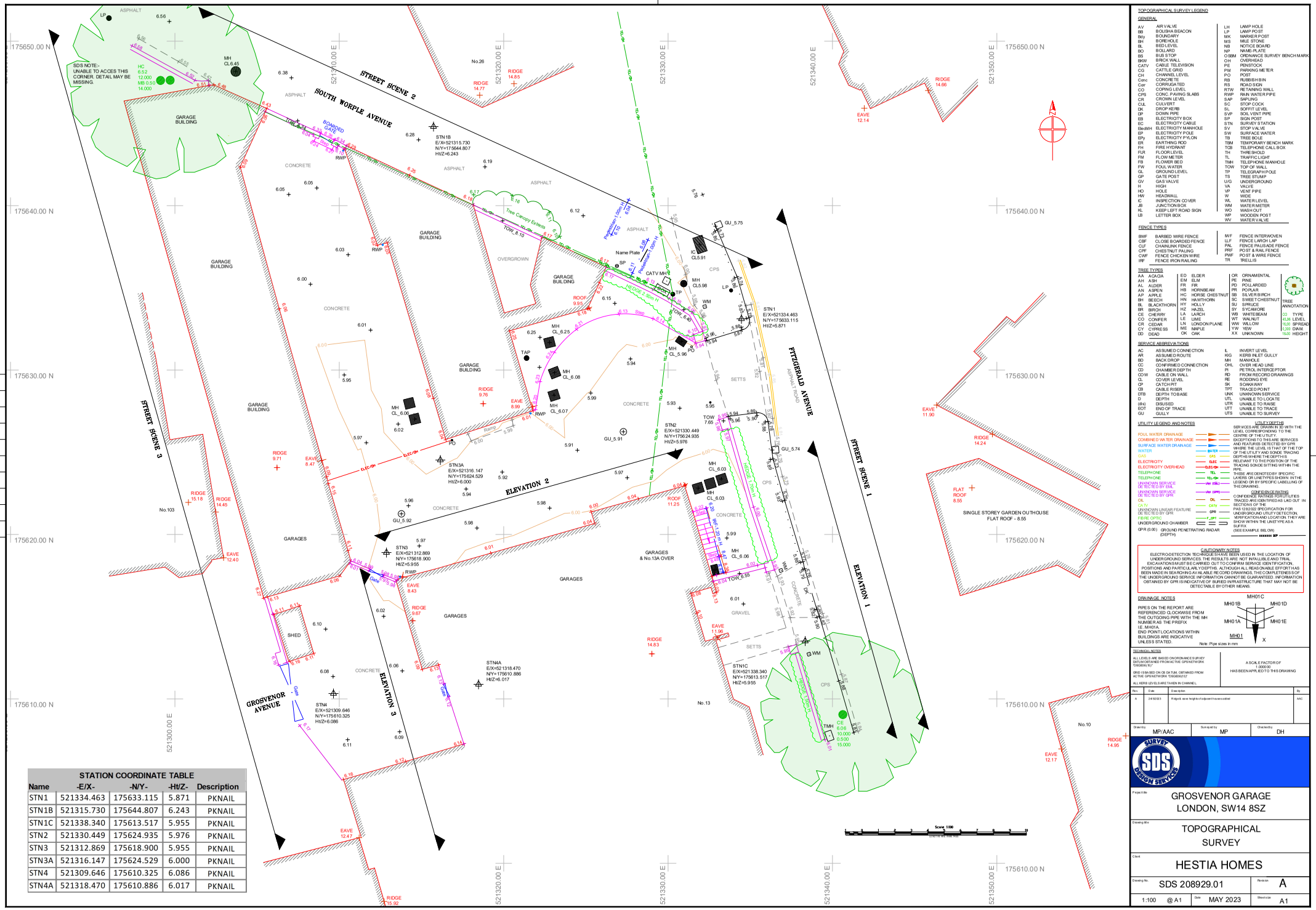
Project Title: Grosvenor Garage
Fitzgerald Avenue
SW14 8SZ

Drawing Title: Proposed Site Information Plan

Scale	Date	Drawn
1:200 A1	02.2024	EB

Job No.	Drawing No.	Rev.
HA24-267	S003B	B

APPENDIX B
TOPOGRAPHICAL SURVEY



STATION COORDINATE TABLE

Name	-E/X-	-N/Y-	-Ht/Z-	Description
STN1	521334.463	175633.115	5.871	PKNAIL
STN1B	521315.730	175644.807	6.243	PKNAIL
STN1C	521338.340	175613.517	5.955	PKNAIL
STN2	521330.449	175624.935	5.976	PKNAIL
STN3	521312.869	175618.900	5.955	PKNAIL
STN3A	521316.147	175624.529	6.000	PKNAIL
STN4	521309.646	175610.325	6.086	PKNAIL
STN4A	521318.470	175610.886	6.017	PKNAIL

TOPOGRAPHICAL SURVEY LEGEND

GENERAL

AV	AIR VALVE	LH	LAMP HOLE
BB	BOUSHA BEACON	LP	LAMP POST
Bdy	BOUNDARY	MK	MARKER POST
BH	BORE HOLE	MS	MILE STONE
BL	BEED LEVEL	NB	NOTICE BOARD
BO	BOLLARD	NP	NAME PLATE
BS	BUS STOP	OSBM	ORDNANCE SURVEY BENCH MARK
BWW	BRICK WALL	OH	OVERHEAD
CATV	CABLE TELEVISION	PE	PENSTOCK
CG	CATTLE GRID	PM	PARKING METER
CH	CHANNEL LEVEL	PO	POST
Conc	CONCRETE	RB	RUBBISH BIN
Corr	CORRUGATED	RS	ROAD SIGN
CO	COPING LEVEL	RTW	RETAINING WALL
CPS	CONC. PAVING SLABS	RWP	RAIN WATER PIPE
CR	CROWN LEVEL	SAP	SAPLING
CUL	CULVERT	SC	STOP COCK
DK	DROP KERB	SL	SOFFIT LEVEL
DP	DOWN PIPE	SVP	SOIL VENT PIPE
EB	ELECTRICITY BOX	SP	SIGN POST
EC	ELECTRICITY CABLE	STN	SURVEY STATION
ElecMH	ELECTRICITY MANHOLE	SV	STOP VALVE
EP	ELECTRICITY POLE	SW	SURFACE WATER
EPy	ELECTRICITY PYLON	TB	TREE BOLE
ER	EARTHING ROD	TBM	TEMPORARY BENCH MARK
FH	FIRE HYDRANT	TCB	TELEPHONE CALL BOX
FLR	FLOOR LEVEL	TH	THRESHOLD
FM	FLOW METER	TL	TRAFFIC LIGHT
FB	FLOWER BED	TMH	TELEPHONE MANHOLE
FW	FOUL WATER	TOW	TOP OF WALL
GL	GROUND LEVEL	TP	TELEGRAPH POLE
GP	GATE POST	TS	TREE STUMP
GV	GAS VALVE	U/G	UNDERGROUND
H	HIGH	VA	VALVE
HO	HOLE	VP	VENT PIPE
HW	HEADWALL	W	WIDE
IC	INSPECTION COVER	WL	WATER LEVEL
JB	JUNCTION BOX	WM	WATER METER
KL	KEEP LEFT ROAD SIGN	WO	WASH OUT
LB	LETTER BOX	WP	WOODEN POST
		WV	WATER VALVE

FENCE TYPES

BWF	BARBED WIRE FENCE	WF	FENCE INTERWOVEN
CBF	CLOSE BOARDED FENCE	LF	FENCE LARCH LAP
CLF	CHAINLINK FENCE	PAL	FENCE PALISADE FENCE
CPF	CHESTNUT PALING	PRF	POST & RAIL FENCE
CWF	FENCE CHICKEN WIRE	PWF	POST & WIRE FENCE
IRF	FENCE IRON RAILING	TR	TRELLIS

TREE TYPES

AA	ACACIA	ED	ELDER	OR	ORNAMENTAL
AH	ASH	EM	ELM	PE	PINE
AL	ALDER	FR	FIR	PO	POLLARDED
AN	ASPEN	HB	HORNBEAM	PR	POPLAR
AP	APPLE	HC	HORSE CHESTNUT	SB	SILVER BIRCH
BH	BEECH	HN	HAWTHORN	SC	SWEET CHESTNUT
BL	BLACKTHORN	HY	HOLLY	SU	SPRUCE
BR	BIRCH	HZ	HAZEL	SY	SYCAMORE
CE	CHERRY	LA	LARCH	WB	WHITEBEAM
CO	CONIFER	LE	LIME	WT	WALNUT
CR	CEDAR	LN	LONDON PLANE	WW	WILLOW
CY	CYPRESS	ME	MAPLE	YW	YEW
DD	DEAD	OK	OAK	XX	UNKNOWN

TREE ANNOTATION: 20 TYPE; 42.06 LEVEL; 10.20 SPREAD; 2.200 DIAM; 15.00 HEIGHT

SERVICE ABBREVIATIONS

AC	ASSUMED CONNECTION	IL	INVERT LEVEL
AR	ASSUMED ROUTE	KG	KERB INLET GULLY
BD	BACK DROP	MH	MANHOLE
CC	CONFIRMED CONNECTION	OHL	OVER HEAD LINE
CD	CHAMBER DEPTH	PI	PETROL INTERCEPTOR
COW	CABLE ON WALL	RD	FROM RECORD DRAWINGS
CL	COVER LEVEL	RE	RODDING EYE
CP	CATCH PIT	SK	SOAKAWAY
CR	CABLE RISER	TPT	TRACED POINT
DTB	DEPTH TO BASE	UNK	UNKNOWN SERVICE
D	DEPTH	UTL	UNABLE TO LOCATE
(dis)	DISUSED	UTR	UNABLE TO RAISE
EOT	END OF TRACE	UTT	UNABLE TO TRACE
GU	GULLY	UTS	UNABLE TO SURVEY

UTILITY LEGEND AND NOTES

FOUL WATER DRAINAGE; COMBINED WATER DRAINAGE; SURFACE WATER DRAINAGE; WATER (WATER); GAS (GAS); ELECTRICITY (ELEC); ELECTRICITY OVERHEAD (ELEC/OH); TELEPHONE (TEL); TELEPHONE (TEL/OH); UNKNOWN SERVICE (UNKNOWN); UNKNOWN SERVICE (GPR); OIL; CATV; UNKNOWN LINEAR FEATURE DETECTED BY GPR; FIBRE OPTIC; UNDERGROUND CHAMBER; GPR (0.00) GROUND PENETRATING RADAR (DEPTH)

UTILITY DEPTHS

SERVICES ARE DRAWN IN 3D WITH THE LEVEL CORRESPONDING TO THE CENTRE OF THE UTILITY. EXCEPTIONS TO THIS ARE SERVICES AND FEATURES DETECTED BY GPR WHERE THE LEVEL IS THAT OF THE TOP OF THE UTILITY AND SONDE TRACING DEPTHS WHERE THE DEPTH IS RELEVANT TO THE POSITION OF THE TRACING SONDE SITTING WITHIN THE PIPE. THESE ARE DENOTED BY SPECIFIC LAYERS OR LINETYPES SHOWN IN THE LEGEND OR BY SPECIFIC LABELLING OF THE DRAWING.

CONFIDENCE RATING

CONFIDENCE RATINGS POTAUTILITIES TRACED ARE GIVEN TO EACH LAID OUT IN SECTIONS OF THE PAS 128:2022 SPECIFICATION FOR UNDERGROUND UTILITY DETECTION, VERIFICATION AND LOCATION. THEY ARE SHOW WITHIN THE LINETYPE AS A SUFFIX (SEE EXAMPLE BELOW)

CAUTIONARY NOTES

ELECTRO DETECTION TECHNIQUES HAVE BEEN USED IN THE LOCATION OF UNDERGROUND SERVICES. THE RESULTS ARE NOT INFALLIBLE AND TRIAL EXCAVATIONS MUST BE CARRIED OUT TO CONFIRM SERVICE IDENTIFICATION, POSITIONS AND PARTICULARLY DEPTHS. ALTHOUGH ALL REASONABLE EFFORT HAS BEEN MADE IN SEARCHING AVAILABLE RECORD DRAWINGS, THE COMPLETENESS OF THE UNDERGROUND SERVICE INFORMATION CANNOT BE GUARANTEED. INFORMATION OBTAINED BY GPR IS INDICATIVE OF BURIED INFRASTRUCTURE THAT MAY NOT BE DETECTABLE BY OTHER MEANS.

DRAINAGE NOTES

PIPES ON THE REPORT ARE REFERENCED CLOCKWISE FROM THE OUTGOING PIPE WITH THE MH NUMBER AS THE PREFIX I.E. MH01A. END POINT LOCATIONS WITHIN BUILDINGS ARE INDICATIVE UNLESS STATED.

MH01C; MH01B; MH01D; MH01A; MH01E; MH01; X

Note: Pipe sizes in mm

TECHNICAL NOTES

ALL LEVELS ARE BASED ON ORDNANCE SURVEY DATUM OBTAINED FROM ACTIVE GPS NETWORK 'OSGB06/07'

GRID IS BASED ON OS DATUM OBTAINED FROM ACTIVE GPS NETWORK 'OSGB06/07'

ALL KERB LEVELS ARE TAKEN IN CHANNEL

A SCALE FACTOR OF 1.0000.00 HAS BEEN APPLIED TO THIS DRAWING

Rev.	Date	Description	By
A	24/10/23	Adjust save heights of adjacent houses added	AAC

Drawn by: MP/AAC | Surveyed by: MP | Checked by: DH

SURVEY DESIGN SERVICES

Project title: GROSVENOR GARAGE LONDON, SW14 8SZ

Drawing title: TOPOGRAPHICAL SURVEY

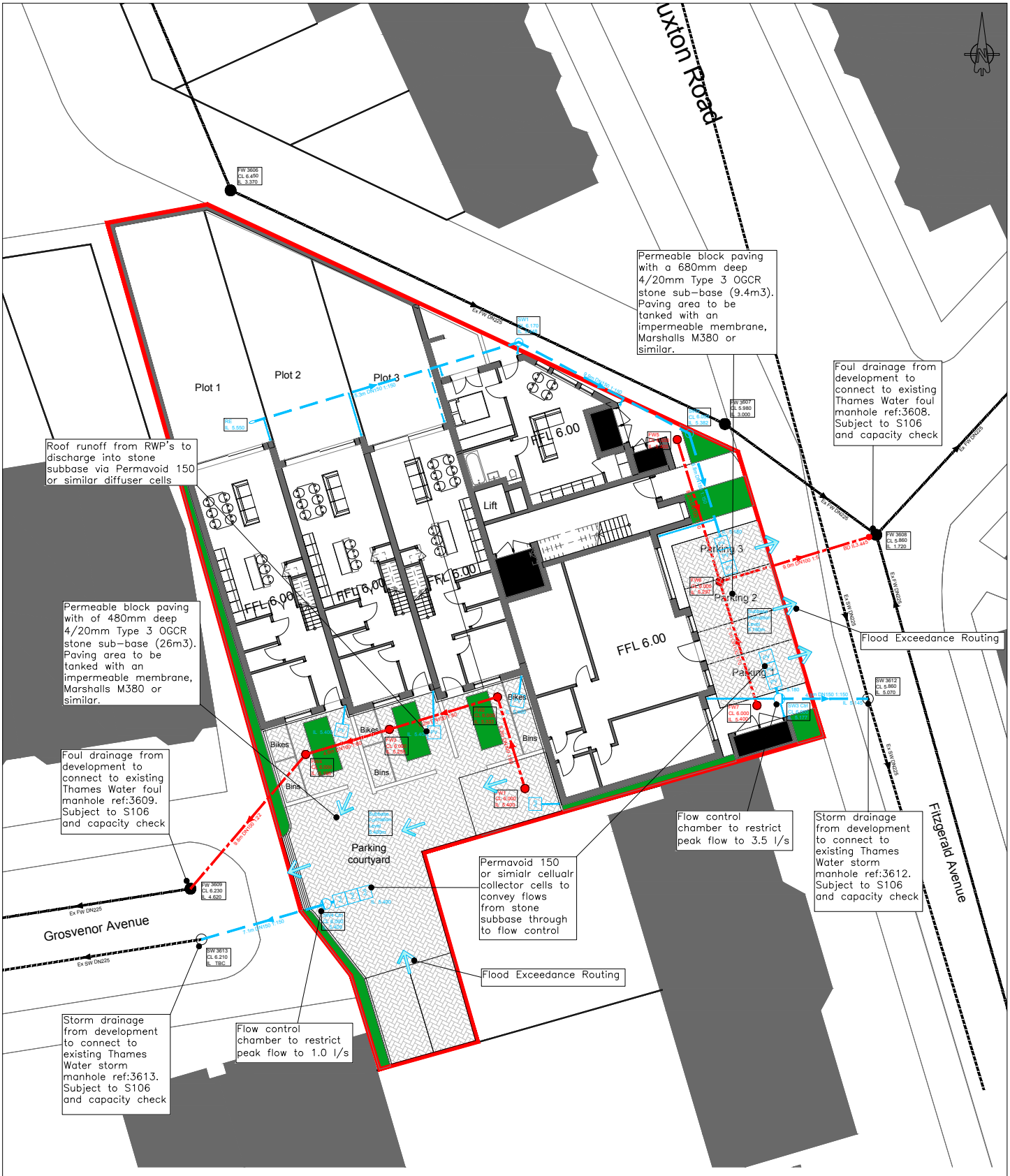
Client: HESTIA HOMES

Drawing No.: SDS 208929.01 | Revision: A

1:100 @ A1 | Date: MAY 2023 | Sheet size: A1

SURVEY DESIGN SERVICES and ASSOC. LTD. UNITS 13 & 14,FOUNDRY BUSINESS PARK, SEAGER ROAD, FAVERSHAM, KENT. ME13 7FD TEL. 01795 594110 www.surveydesignservices.co.uk

APPENDIX C
FOUL AND SURFACE WATER DRAINAGE STRATEGY



REV. No.	DATE	DESCRIPTION	DRAWN	CHECKED

Client

Hestia Homes

Project

Grosvenor Garage
Fitzgerald Avenue, East Sheen, London, SW14 8SZ

Title

Foul and Surface Water Drainage Strategy

MJA CONSULTING
CIVIL & STRUCTURAL ENGINEERS
Ipsum Court, 24 The Quadrant,
Abingdon Science Park, Abingdon
Oxon, OX14 3YS
Tel: 01235 555173
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Scale:	Status:		
1:200 @A3	PRELIMINARY		
Drawn: CP	Project Engineer CP	MJA Project No: 7149	Date: 29/02/24
Drawing Number: 7149-MJA-SW-XX-DR-C-001			Rev: -

APPENDIX D

POST DEVELOPMENT ATTTENUATION CALCULATIONS

ICP SUDS Mean Annual Flood

Input

Return Period (years)	1	Soil	0.300
Area (ha)	0.094	Urban	0.000
SAAR (mm)	600	Region Number	Region 6

Results l/s

QBAR Rural	0.1
QBAR Urban	0.1
Q1 year	0.1
Q1 year	0.1
Q30 years	0.3
Q100 years	0.5

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

Half Drain Time : 26 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	5.601	0.601	0.0	3.5	3.5	8.3	O K
30 min Summer	5.679	0.679	0.0	3.6	3.6	9.4	O K
60 min Summer	5.678	0.678	0.0	3.6	3.6	9.4	O K
120 min Summer	5.590	0.590	0.0	3.5	3.5	8.1	O K
180 min Summer	5.486	0.486	0.0	3.5	3.5	6.7	O K
240 min Summer	5.364	0.364	0.0	3.5	3.5	5.0	O K
360 min Summer	5.204	0.204	0.0	3.5	3.5	2.8	O K
480 min Summer	5.130	0.130	0.0	3.4	3.4	1.8	O K
600 min Summer	5.103	0.103	0.0	3.1	3.1	1.4	O K
720 min Summer	5.090	0.090	0.0	2.7	2.7	1.2	O K
960 min Summer	5.075	0.075	0.0	2.2	2.2	1.0	O K
1440 min Summer	5.061	0.061	0.0	1.6	1.6	0.8	O K
2160 min Summer	5.050	0.050	0.0	1.1	1.1	0.7	O K
2880 min Summer	5.044	0.044	0.0	0.9	0.9	0.6	O K
4320 min Summer	5.036	0.036	0.0	0.6	0.6	0.5	O K
5760 min Summer	5.032	0.032	0.0	0.5	0.5	0.4	O K
7200 min Summer	5.029	0.029	0.0	0.4	0.4	0.4	O K
8640 min Summer	5.027	0.027	0.0	0.4	0.4	0.4	O K
10080 min Summer	5.025	0.025	0.0	0.3	0.3	0.3	O K
15 min Winter	5.601	0.601	0.0	3.5	3.5	8.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	140.294	0.0	10.6	16
30 min Summer	91.420	0.0	13.9	26
60 min Summer	56.713	0.0	17.3	44
120 min Summer	33.998	0.0	20.8	78
180 min Summer	24.878	0.0	22.9	112
240 min Summer	19.821	0.0	24.3	142
360 min Summer	14.335	0.0	26.4	198
480 min Summer	11.393	0.0	28.0	252
600 min Summer	9.527	0.0	29.2	308
720 min Summer	8.228	0.0	30.3	368
960 min Summer	6.525	0.0	32.0	490
1440 min Summer	4.699	0.0	34.6	724
2160 min Summer	3.378	0.0	37.3	1100
2880 min Summer	2.671	0.0	39.2	1468
4320 min Summer	1.916	0.0	42.1	2192
5760 min Summer	1.512	0.0	44.2	2936
7200 min Summer	1.257	0.0	45.9	3624
8640 min Summer	1.082	0.0	47.2	4280
10080 min Summer	0.952	0.0	48.4	5024
15 min Winter	140.294	0.0	10.6	16

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	5.678	0.678	0.0	3.6	3.6	9.4	O K
60 min Winter	5.660	0.660	0.0	3.5	3.5	9.1	O K
120 min Winter	5.516	0.516	0.0	3.5	3.5	7.1	O K
180 min Winter	5.327	0.327	0.0	3.5	3.5	4.5	O K
240 min Winter	5.194	0.194	0.0	3.5	3.5	2.7	O K
360 min Winter	5.102	0.102	0.0	3.1	3.1	1.4	O K
480 min Winter	5.083	0.083	0.0	2.5	2.5	1.1	O K
600 min Winter	5.072	0.072	0.0	2.1	2.1	1.0	O K
720 min Winter	5.066	0.066	0.0	1.8	1.8	0.9	O K
960 min Winter	5.057	0.057	0.0	1.4	1.4	0.8	O K
1440 min Winter	5.047	0.047	0.0	1.0	1.0	0.6	O K
2160 min Winter	5.039	0.039	0.0	0.7	0.7	0.5	O K
2880 min Winter	5.034	0.034	0.0	0.6	0.6	0.5	O K
4320 min Winter	5.029	0.029	0.0	0.4	0.4	0.4	O K
5760 min Winter	5.025	0.025	0.0	0.3	0.3	0.3	O K
7200 min Winter	5.023	0.023	0.0	0.3	0.3	0.3	O K
8640 min Winter	5.021	0.021	0.0	0.2	0.2	0.3	O K
10080 min Winter	5.020	0.020	0.0	0.2	0.2	0.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	91.420	0.0	13.9	28
60 min Winter	56.713	0.0	17.3	46
120 min Winter	33.998	0.0	20.8	84
180 min Winter	24.878	0.0	22.9	114
240 min Winter	19.821	0.0	24.3	140
360 min Winter	14.335	0.0	26.4	188
480 min Winter	11.393	0.0	28.0	248
600 min Winter	9.527	0.0	29.2	308
720 min Winter	8.228	0.0	30.3	366
960 min Winter	6.525	0.0	32.0	494
1440 min Winter	4.699	0.0	34.6	734
2160 min Winter	3.378	0.0	37.3	1096
2880 min Winter	2.671	0.0	39.2	1448
4320 min Winter	1.916	0.0	42.1	2248
5760 min Winter	1.512	0.0	44.2	2880
7200 min Winter	1.257	0.0	45.9	3648
8640 min Winter	1.082	0.0	47.2	4352
10080 min Winter	0.952	0.0	48.4	5024

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	1.000
Region	England and Wales	Cv (Winter)	1.000
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.418	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.031

Time (mins) From:	To:	Area (ha)
0	4	0.031

Model Details

Storage is Online Cover Level (m) 6.000

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	5.0
Membrane Percolation (mm/hr)	1000	Length (m)	9.2
Max Percolation (l/s)	12.8	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	5.000	Membrane Depth (m)	0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0094-3500-0650-3500
Design Head (m)	0.650
Design Flow (l/s)	3.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	94
Invert Level (m)	5.000
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.650	3.5
Flush-Flo™	0.195	3.5
Kick-Flo®	0.442	2.9
Mean Flow over Head Range	-	3.0

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.0	1.200	4.6	3.000	7.1	7.000	10.6
0.200	3.5	1.400	5.0	3.500	7.7	7.500	11.0
0.300	3.4	1.600	5.3	4.000	8.2	8.000	11.4
0.400	3.2	1.800	5.6	4.500	8.6	8.500	11.7
0.500	3.1	2.000	5.9	5.000	9.1	9.000	12.1
0.600	3.4	2.200	6.2	5.500	9.5	9.500	12.4
0.800	3.8	2.400	6.4	6.000	9.9		
1.000	4.3	2.600	6.7	6.500	10.3		

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

Half Drain Time : 221 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	5.269	0.269	0.0	1.0	1.0	14.5	O K
30 min Summer	5.350	0.350	0.0	1.0	1.0	18.9	O K
60 min Summer	5.420	0.420	0.0	1.0	1.0	22.7	O K
120 min Summer	5.467	0.467	0.0	1.0	1.0	25.2	O K
180 min Summer	5.474	0.474	0.0	1.0	1.0	25.6	O K
240 min Summer	5.467	0.467	0.0	1.0	1.0	25.2	O K
360 min Summer	5.450	0.450	0.0	1.0	1.0	24.3	O K
480 min Summer	5.431	0.431	0.0	1.0	1.0	23.3	O K
600 min Summer	5.412	0.412	0.0	1.0	1.0	22.2	O K
720 min Summer	5.392	0.392	0.0	1.0	1.0	21.2	O K
960 min Summer	5.352	0.352	0.0	1.0	1.0	19.0	O K
1440 min Summer	5.268	0.268	0.0	1.0	1.0	14.5	O K
2160 min Summer	5.177	0.177	0.0	1.0	1.0	9.5	O K
2880 min Summer	5.120	0.120	0.0	1.0	1.0	6.5	O K
4320 min Summer	5.072	0.072	0.0	0.9	0.9	3.9	O K
5760 min Summer	5.057	0.057	0.0	0.7	0.7	3.1	O K
7200 min Summer	5.049	0.049	0.0	0.6	0.6	2.6	O K
8640 min Summer	5.043	0.043	0.0	0.5	0.5	2.3	O K
10080 min Summer	5.039	0.039	0.0	0.5	0.5	2.1	O K
15 min Winter	5.269	0.269	0.0	1.0	1.0	14.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	140.294	0.0	15.1	18
30 min Summer	91.420	0.0	20.0	33
60 min Summer	56.713	0.0	25.1	62
120 min Summer	33.998	0.0	30.3	122
180 min Summer	24.878	0.0	33.3	180
240 min Summer	19.821	0.0	35.4	210
360 min Summer	14.335	0.0	38.5	272
480 min Summer	11.393	0.0	40.8	340
600 min Summer	9.527	0.0	42.6	410
720 min Summer	8.228	0.0	44.2	478
960 min Summer	6.525	0.0	46.7	616
1440 min Summer	4.699	0.0	50.4	866
2160 min Summer	3.378	0.0	54.2	1216
2880 min Summer	2.671	0.0	57.0	1556
4320 min Summer	1.916	0.0	60.8	2208
5760 min Summer	1.512	0.0	63.7	2936
7200 min Summer	1.257	0.0	65.8	3672
8640 min Summer	1.082	0.0	67.5	4376
10080 min Summer	0.952	0.0	68.8	5136
15 min Winter	140.294	0.0	15.1	18

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	5.350	0.350	0.0	1.0	1.0	18.9	O K
60 min Winter	5.420	0.420	0.0	1.0	1.0	22.7	O K
120 min Winter	5.468	0.468	0.0	1.0	1.0	25.3	O K
180 min Winter	5.476	0.476	0.0	1.0	1.0	25.7	O K
240 min Winter	5.469	0.469	0.0	1.0	1.0	25.3	O K
360 min Winter	5.445	0.445	0.0	1.0	1.0	24.1	O K
480 min Winter	5.421	0.421	0.0	1.0	1.0	22.7	O K
600 min Winter	5.393	0.393	0.0	1.0	1.0	21.2	O K
720 min Winter	5.363	0.363	0.0	1.0	1.0	19.6	O K
960 min Winter	5.295	0.295	0.0	1.0	1.0	15.9	O K
1440 min Winter	5.186	0.186	0.0	1.0	1.0	10.1	O K
2160 min Winter	5.094	0.094	0.0	1.0	1.0	5.1	O K
2880 min Winter	5.066	0.066	0.0	0.8	0.8	3.6	O K
4320 min Winter	5.048	0.048	0.0	0.6	0.6	2.6	O K
5760 min Winter	5.040	0.040	0.0	0.5	0.5	2.2	O K
7200 min Winter	5.036	0.036	0.0	0.4	0.4	1.9	O K
8640 min Winter	5.032	0.032	0.0	0.3	0.3	1.7	O K
10080 min Winter	5.030	0.030	0.0	0.3	0.3	1.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	91.420	0.0	20.0	33
60 min Winter	56.713	0.0	25.1	62
120 min Winter	33.998	0.0	30.3	118
180 min Winter	24.878	0.0	33.3	174
240 min Winter	19.821	0.0	35.4	226
360 min Winter	14.335	0.0	38.5	282
480 min Winter	11.393	0.0	40.8	360
600 min Winter	9.527	0.0	42.6	438
720 min Winter	8.228	0.0	44.2	514
960 min Winter	6.525	0.0	46.7	652
1440 min Winter	4.699	0.0	50.4	892
2160 min Winter	3.378	0.0	54.2	1192
2880 min Winter	2.671	0.0	57.0	1500
4320 min Winter	1.916	0.0	60.9	2208
5760 min Winter	1.512	0.0	63.7	2912
7200 min Winter	1.257	0.0	65.8	3656
8640 min Winter	1.082	0.0	67.5	4408
10080 min Winter	0.952	0.0	68.8	5144

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	1.000
Region	England and Wales	Cv (Winter)	1.000
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.418	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.046

Time (mins) From:	To:	Area (ha)
0	4	0.046

Model Details

Storage is Online Cover Level (m) 6.000

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	18.0
Membrane Percolation (mm/hr)	1000	Length (m)	10.0
Max Percolation (l/s)	50.0	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	5.000	Membrane Depth (m)	0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0054-1000-0500-1000
Design Head (m)	0.500
Design Flow (l/s)	1.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	54
Invert Level (m)	5.000
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.500	1.0
Flush-Flo™	0.151	1.0
Kick-Flo®	0.332	0.8
Mean Flow over Head Range	-	0.9

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.0	1.200	1.5	3.000	2.2	7.000	3.4
0.200	1.0	1.400	1.6	3.500	2.4	7.500	3.5
0.300	0.9	1.600	1.7	4.000	2.6	8.000	3.6
0.400	0.9	1.800	1.8	4.500	2.7	8.500	3.7
0.500	1.0	2.000	1.9	5.000	2.8	9.000	3.8
0.600	1.1	2.200	1.9	5.500	3.0	9.500	3.9
0.800	1.2	2.400	2.0	6.000	3.1		
1.000	1.4	2.600	2.1	6.500	3.2		

APPENDIX E
LBR SUDS PRO-FORMA

LONDON BOROUGH OF RICHMOND UPON THAMES

GREATER**LONDON**AUTHORITY

LoDEG

1. Project & Site Details

Project / Site Name (including sub-catchment / stage / phase where appropriate)	Grosvenor Garage
Address & post code	Grosvenor Garage, Fitzgerald Avenue East Sheen London, SW14 8SZ
OS Grid ref. (Easting, Northing)	E 521334
	N 175633
LPA reference (if applicable)	
Brief description of proposed work	Demolition of all existing garage buildings within the site for the construction of up to 8No. residential dwellings (3No. houses and 5No. apartments) and commercial space.
Total site Area	940 m^2
Total existing impervious area	940 m^2
Total proposed impervious area	*+10% for Urban Creep 770* m^2
Is the site in a surface water flood risk catchment (ref. local Surface Water Management Plan)?	No
Existing drainage connection type and location	To Thames Water storm sewer within Fitzgerald Avenue and Grosvenor Avenue
Designer Name	Chris Pendle
Designer Position	Drainage Engineer
Designer Company	MJA Consulting

2. Proposed Discharge Arrangements

2a. Infiltration Feasibility

Superficial geology classification	Kempton Park Gravel	
Bedrock geology classification	London Clay Formation	
Site infiltration rate	TBC	m/s
Depth to groundwater level	TBC	m below ground level
Is infiltration feasible?	TBC	

2b. Drainage Hierarchy

	Feasible (Y/N)	*Proposed (Y/N)*
1 store rainwater for later use	Y	Y
2 use infiltration techniques, such as porous surfaces in non-clay areas	TBC	N
3 attenuate rainwater in ponds or open water features for gradual release	N	N
4 attenuate rainwater by storing in tanks or sealed water features for gradual release	Y	Y
5 discharge rainwater direct to a watercourse	N	N
6 discharge rainwater to a surface water sewer/drain	Y	Y
7 discharge rainwater to the combined sewer.	N	N

2c. Proposed Discharge Details

Proposed discharge location	Thames Water public storm sewer (ref: 3612 & 3613)
Has the owner/regulator of the discharge location been consulted?	Thames Water are currently being consulted (S106 and capacity check)

LONDON BOROUGH OF RICHMOND UPON THAMES

GREATER**LONDON**AUTHORITY

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3. Drainage Strategy

3a. Discharge Rates & Required Storage

	Greenfield (GF) runoff rate (l/s)	*Existing discharge rate (l/s)*	*Required storage for ~~GF rate (m^3)~~ 50% reduction in 1 year peak rate*	*Proposed discharge rate (l/s)*
Qbar				
1 in 1	0.1	9.1		4.5
1 in 30	0.3	22.6		4.5
1 in 100	0.5	28.8		4.5
1 in 100 + CC			35.4	4.5
Climate change allowance used		40%		
3b. Principal Method of Flow Control		Vortex control		

3c. Proposed SuDS Measures

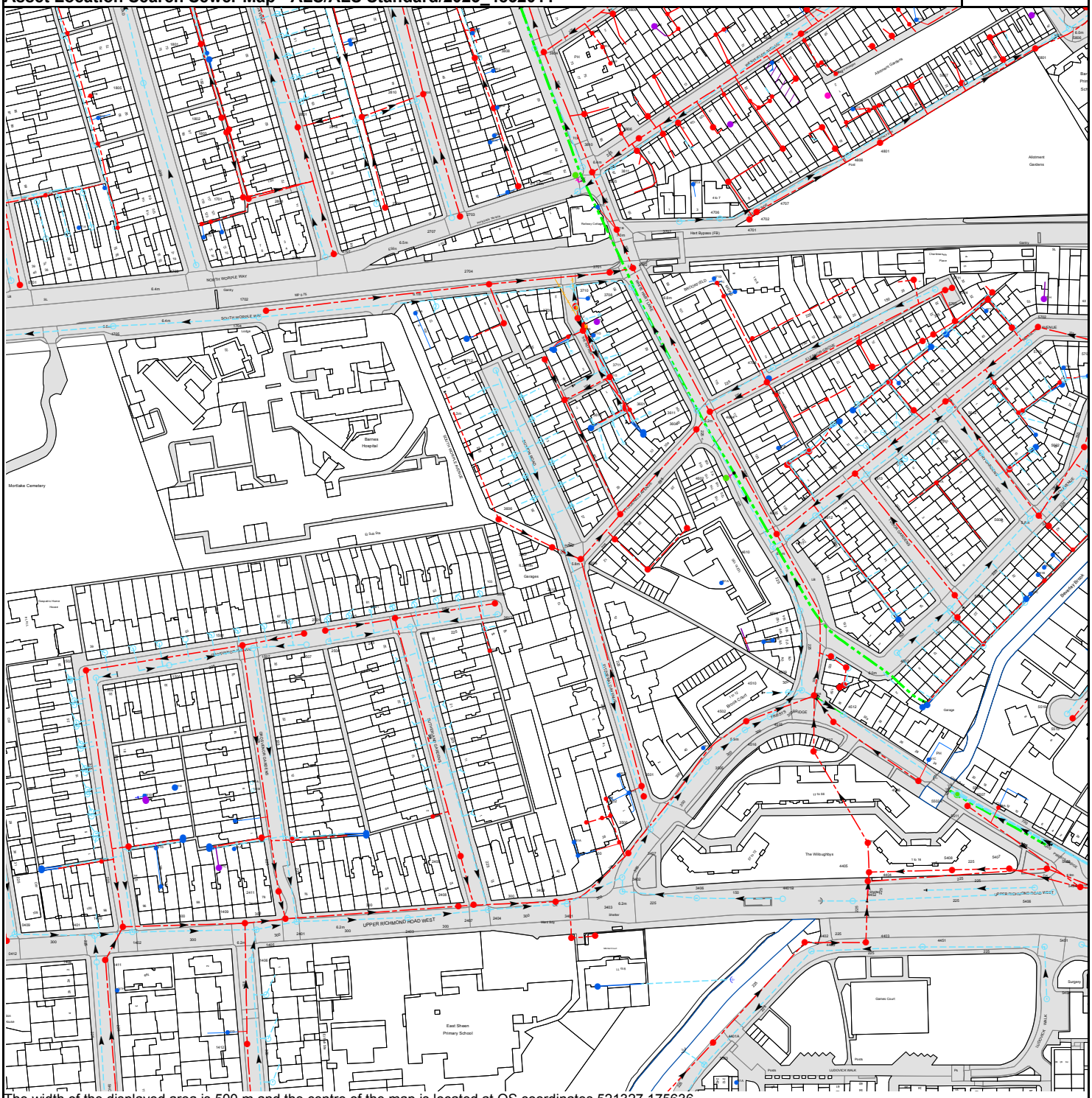
	Catchment area (m^2)	*Plan area (m^2)*	*Storage vol. (m^3)*
Rainwater harvesting	0		0
Infiltration systems	0		0
Green roofs	0	0	0
Blue roofs	0	0	0
Filter strips	0	0	0
Filter drains	0	0	0
Bioretention / tree pits	0	0	0
Pervious pavements	770 0	226 0	35.4 0
Swales	0	0	0
Basins/ponds	0	0	0
Attenuation tanks	0		0
Total	770 **0**	226 **0**	35.4 **0**

4. Supporting Information

4a. Discharge & Drainage Strategy	*Page/section of drainage report*
Infiltration feasibility (2a) – geotechnical factual and interpretive reports, including infiltration results	TBC No testing to date
Drainage hierarchy (2b)	Section 6, Page 21
Proposed discharge details (2c) – utility plans, correspondence / approval from owner/regulator of discharge location	Appendix C - Drainage Layout
Discharge rates & storage (3a) – detailed hydrologic and hydraulic calculations	Appendix D - Calcs
Proposed SuDS measures & specifications (3b)	Section 6, Page 21 & 22 Appendix C - Drainage Layout
4b. Other Supporting Details	*Page/section of drainage report*
Detailed Development Layout	Appendix A - Site Layout
Detailed drainage design drawings, including exceedance flow routes	Appendix C - Drainage Layout
Detailed landscaping plans	By others
Maintenance strategy	Section 6 - Page 25,26 & 27
Demonstration of how the proposed SuDS measures improve:	
a) water quality of the runoff?	Pg.24 & 25 Para 6.15-6.22
b) biodiversity?	N/A
c) amenity?	N/A

APPENDIX F
PUBLIC SEWER RECORDS

Asset Location Search Sewer Map - ALS/ALS Standard/2023_4832011



The width of the displayed area is 500 m and the centre of the map is located at OS coordinates 521327,175636

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
48WP	n/a	n/a
48WX	n/a	n/a
48WS	n/a	n/a
48WT	n/a	n/a
481Q	9.85	n/a
4805	5.91	3.67
48XT	n/a	n/a
481D	n/a	n/a
48YP	n/a	n/a
481C	n/a	n/a
481B	n/a	n/a
4807	n/a	n/a
481A	n/a	n/a
48YV	n/a	n/a
48TV	n/a	n/a
481P	n/a	n/a
48YY	n/a	n/a
48ZV	n/a	n/a
48ZT	n/a	n/a
48VS	n/a	n/a
481N	n/a	n/a
58XT	n/a	n/a
5807	n/a	n/a
58YP	n/a	n/a
58XZ	n/a	n/a
18TR	n/a	n/a
18TT	n/a	n/a
18VR	n/a	n/a
1802	6.15	5.19
1803	6.12	5.11
18VP	n/a	n/a
28YS	n/a	n/a
28YP	n/a	n/a
28XX	n/a	n/a
28XS	n/a	n/a
2801	6.24	4.11
28WZ	n/a	n/a
2808	6.23	4.87
281C	n/a	n/a
281F	n/a	n/a
2814	n/a	n/a
2804	n/a	n/a
2810	n/a	n/a
2805	6.31	4.2
281A	n/a	n/a
281B	n/a	n/a
2806	n/a	n/a
2811	6.35	5.21
281H	n/a	n/a
381C	n/a	n/a
381D	n/a	n/a
381E	n/a	n/a
381M	n/a	n/a
18XP	n/a	n/a
18YT	n/a	n/a
181B	n/a	n/a
18XZ	n/a	n/a
18YS	n/a	n/a
181C	n/a	n/a
1805	6.23	4.77
1801	6.15	4.65
3706	6.44	.43
381L	n/a	n/a
381A	n/a	n/a
3802	n/a	n/a
3805	6.46	.69
3810	6.38	5.12
3811	6.29	2.76
38WR	n/a	n/a
38YZ	n/a	n/a
38XS	n/a	n/a
48VW	n/a	n/a
38ZQ	n/a	n/a
38YP	n/a	n/a
38WZ	n/a	n/a
38ZS	n/a	n/a
38XW	n/a	n/a
38XX	n/a	n/a
381F	n/a	n/a
3804	6.51	.86
3808	6.48	4.55
381H	n/a	n/a
381G	n/a	n/a
38VW	n/a	n/a
381K	n/a	n/a
38VV	n/a	n/a
38TZ	n/a	n/a
3807	n/a	n/a
4706	5.81	4.98
471A	6.18	3.19
48SS	n/a	n/a

Manhole Reference	Manhole Cover Level	Manhole Invert Level
481F	n/a	n/a
4701	n/a	n/a
4702	5.62	4.2
48WR	n/a	n/a
4707	6.42	4.87
48WY	n/a	n/a
48SY	n/a	n/a
48SX	n/a	n/a
48TQ	n/a	n/a
4806	5.58	4.67
481H	n/a	n/a
4709	n/a	n/a
481G	n/a	n/a
4801	5.57	3.97
47WW	n/a	n/a
5711	n/a	n/a
57VZ	n/a	n/a
5705	n/a	n/a
5704	n/a	n/a
57TP	n/a	n/a
571E	n/a	n/a
57TT	n/a	n/a
57VV	n/a	n/a
57SX	n/a	n/a
0708	5.92	4.73
0701	6	3.72
07WQ	n/a	n/a
071E	n/a	n/a
07WR	n/a	n/a
17YY	n/a	n/a
17YZ	n/a	n/a
171A	n/a	n/a
17ZP	n/a	n/a
17ZV	n/a	n/a
18TZ	n/a	n/a
1705	6.43	4.6
17YW	n/a	n/a
17ZT	n/a	n/a
1703	6.45	5.02
171B	n/a	n/a
171G	n/a	n/a
37XR	n/a	n/a
37XS	n/a	n/a
37YZ	n/a	n/a
37WR	n/a	n/a
37ZP	n/a	n/a
37YY	n/a	n/a
37XP	n/a	n/a
371E	n/a	n/a
371O	n/a	n/a
37XQ	n/a	n/a
371N	6.24	4.24
37XX	n/a	n/a
37VZ	n/a	n/a
371F	n/a	n/a
37WY	n/a	n/a
371J	6.34	4.39
37WZ	n/a	n/a
3709	6.31	5.4
37XZ	n/a	n/a
371I	n/a	n/a
3708	6.48	5.03
3710	6.24	5.07
3701	6.59	1.2
3702	6.75	1.06
371B	6.6	.9
3707	5.84	5.02
371C	n/a	n/a
371P	n/a	n/a
47XV	n/a	n/a
4705	5.56	2.48
47XS	n/a	n/a
4708	5.67	5.05
46TW	n/a	n/a
46SZ	n/a	n/a
46VW	n/a	n/a
47YY	n/a	n/a
47XP	n/a	n/a
47XQ	n/a	n/a
47ZV	n/a	n/a
47YZ	n/a	n/a
46WT	n/a	n/a
471B	n/a	n/a
46XW	n/a	n/a
46XT	n/a	n/a
47WP	n/a	n/a
57WS	n/a	n/a
57WQ	n/a	n/a
57TQ	n/a	n/a
5703	5.68	3.22
57VP	n/a	n/a
5612	5.67	4.5
57YR	n/a	n/a

Manhole Reference	Manhole Cover Level	Manhole Invert Level
57XP	n/a	n/a
3604	6.01	1.49
36SX	n/a	n/a
36TV	n/a	n/a
36TR	n/a	n/a
36TP	n/a	n/a
36ZR	n/a	n/a
36TS	n/a	n/a
36TQ	n/a	n/a
36TT	n/a	n/a
4604	6.23	1.28
36ZV	n/a	n/a
3611	6.19	4.93
3610	6.2	5.62
3601	6.2	4.44
37ZQ	n/a	n/a
37WW	n/a	n/a
37XW	n/a	n/a
371H	6.1	3.77
37YV	n/a	n/a
37ZT	n/a	n/a
37YW	n/a	n/a
37XT	n/a	n/a
371G	6.24	4.02
37XV	n/a	n/a
3712	6.27	5.41
3711	6.14	4.64
3705	6.09	5.41
16ZX	n/a	n/a
26WV	n/a	n/a
26ZV	n/a	n/a
2601	6.22	4.41
26ZR	n/a	n/a
26YY	n/a	n/a
26YT	n/a	n/a
26YP	n/a	n/a
26XW	n/a	n/a
26XR	n/a	n/a
26WY	n/a	n/a
27YZ	n/a	n/a
27YQ	n/a	n/a
1704	6.04	5.28
271A	n/a	n/a
1702	6.43	2.63
27ZX	n/a	n/a
2704	6.26	1.81
2706	6.43	4.98
2701	6.55	4.59
171F	n/a	n/a
171C	n/a	n/a
2707	6.46	4.9
2703	6.59	4.61
2702	8.05	5.57
2708	6.33	5.67
17ZW	n/a	n/a
1701	5.89	4.72
3609	6.23	4.62
3613	6.21	n/a
3606	6.46	3.37
36YZ	n/a	n/a
36YQ	n/a	n/a
36XT	n/a	n/a
36WZ	n/a	n/a
36YV	n/a	n/a
36XX	n/a	n/a
3607	5.99	3
36WV	n/a	n/a
36WQ	n/a	n/a
3612	5.86	5.07
3608	5.86	1.72
36VR	n/a	n/a
36VS	n/a	n/a
36VV	n/a	n/a
3605	5.9	2.58
36TW	n/a	n/a
36SZ	n/a	n/a
36TY	n/a	n/a
36VW	n/a	n/a
36VX	n/a	n/a
461A	n/a	n/a
4602	n/a	n/a
451A	n/a	n/a
4610	6.05	4.73
4605	6.11	1.44
15SV	n/a	n/a
15SY	n/a	n/a
15TQ	n/a	n/a
15TT	n/a	n/a
15TX	n/a	n/a
15VP	n/a	n/a
15VS	n/a	n/a
15VW	n/a	n/a
15VZ	n/a	n/a

Manhole Reference	Manhole Cover Level	Manhole Invert Level
1505	6.43	5.12
1502	6.33	3.92
1506	6.36	5.06
15ZX	n/a	n/a
15ZT	n/a	n/a
1501	6.37	4.36
15ZQ	n/a	n/a
15YY	n/a	n/a
15YV	n/a	n/a
15YR	n/a	n/a
1405	6.14	4.64
1409	6.12	2.62
2401	n/a	n/a
2410	n/a	n/a
2403	6.18	4.61
2404	6.1	4.58
2408	6.12	2.22
2407	6.23	2.19
2411	n/a	n/a
2409	6.21	3.86
25QT	n/a	n/a
15QQ	n/a	n/a
15QR	n/a	n/a
25QP	n/a	n/a
25QW	n/a	n/a
25QR	n/a	n/a
251A	n/a	n/a
151B	n/a	n/a
151A	n/a	n/a
251B	n/a	n/a
1507	6.41	4.97
2507	6.37	5.05
2508	6.39	5.03
2502	6.41	4.72
2501	6.41	4.63
25ZY	n/a	n/a
2509	6.24	4.87
1410	6.3	2.79
14YP	n/a	n/a
14XY	n/a	n/a
1402	6.3	4.78
151D	n/a	n/a
151H	n/a	n/a
151F	n/a	n/a
141G	n/a	n/a
141F	n/a	n/a
151E	n/a	n/a
15QP	n/a	n/a
15PY	n/a	n/a
14YT	n/a	n/a
14YR	n/a	n/a
141C	n/a	n/a
141A	n/a	n/a
151C	n/a	n/a
4402	6.55	3.02
34ZW	n/a	n/a
34ZX	n/a	n/a
3401	6.1	4.45
3408	6.09	2.08
4401B	6.45	5.02
3406	6.19	5.02
3403	6.16	4.4
3402	n/a	n/a
3407	6.08	1.93
3506	5.95	4.44
3502	n/a	n/a
3501	5.96	3.14
3505	5.73	4.38
4503	n/a	n/a
351E	n/a	n/a
4516	5.72	4.35
4502	5.89	1.74
4515	5.83	4.3
4508	6.07	1.59
4510	4.01	4.31
4509	6.06	4.3
45ZV	n/a	n/a
45ZQ	n/a	n/a
0412	6.41	3.74
0409	6.4	4.93
04XY	n/a	n/a
04XZ	n/a	n/a
15SR	n/a	n/a

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

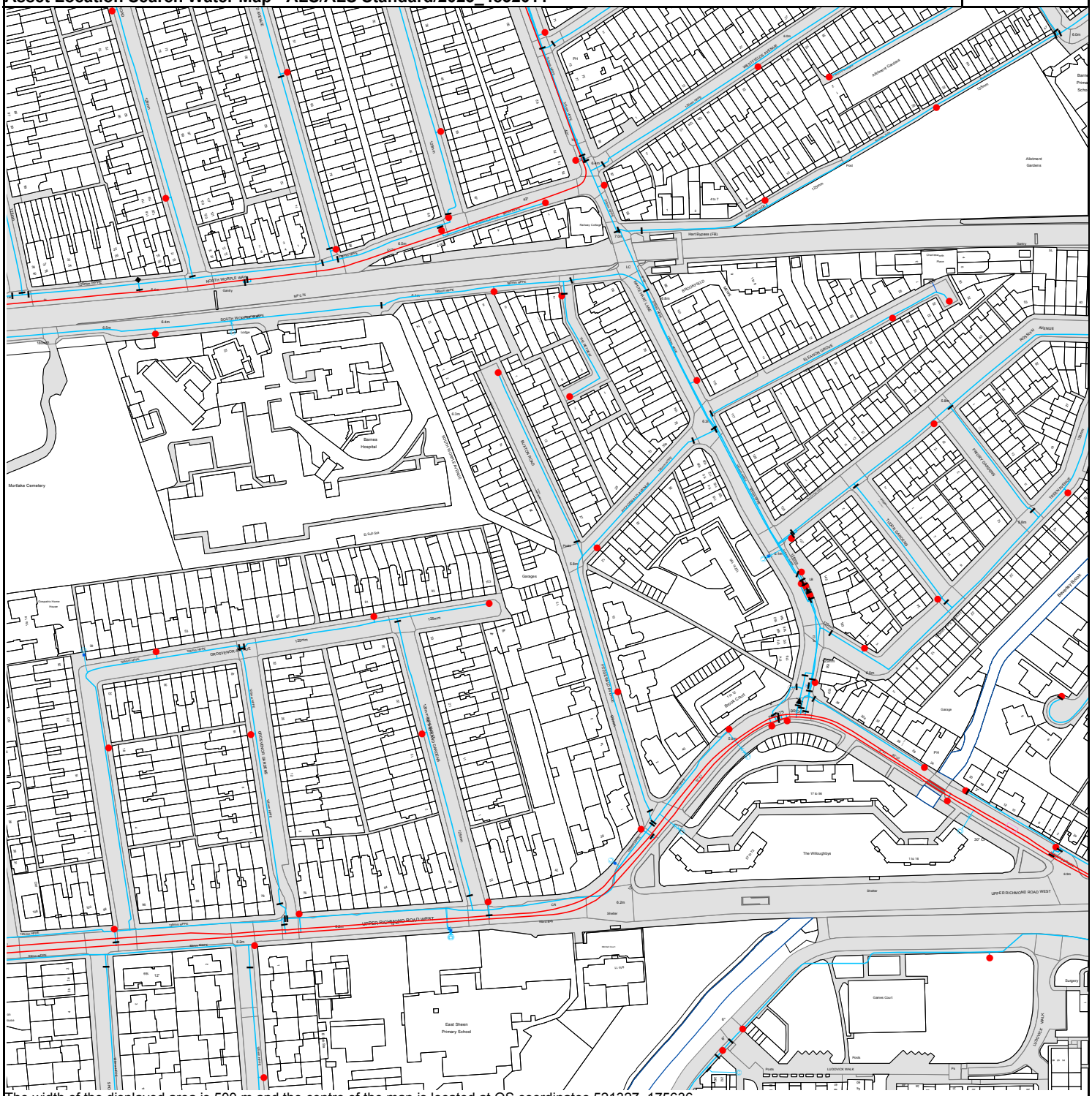
- Casement — Ducts may contain high voltage cables. Please check with Thames Water.
- Conduit Bridge
- Subway
- Tunnel

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.

Asset Location Search Water Map - ALS/ALS Standard/2023_4832011



The width of the displayed area is 500 m and the centre of the map is located at OS coordinates 521327, 175636.

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.

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Asset Location Search - Water Key

Water Pipes (Operated & Maintained by Thames Water)

Distribution Main: The most common pipe shown on water maps. With few exceptions, domestic connections are only made to distribution mains.

Trunk Main: A main carrying water from a source of supply to a treatment plant or reservoir, or from one treatment plant or reservoir to another. Also a main transferring water in bulk to smaller water mains used for supplying individual customers.

Supply Main: A supply main indicates that the water main is used as a supply for a single property or group of properties.

Fire Main: Where a pipe is used as a fire supply, the word FIRE will be displayed along the pipe.

Metered Pipe: A metered main indicates that the pipe in question supplies water for a single property or group of properties and that quantity of water passing through the pipe is metered even though there may be no meter symbol shown.

Transmission Tunnel: A very large diameter water pipe. Most tunnels are buried very deep underground. These pipes are not expected to affect the structural integrity of buildings shown on the map provided.

Proposed Main: A main that is still in the planning stages or in the process of being laid. More details of the proposed main and its reference number are generally included near the main.

PIPE DIAMETER	DEPTH BELOW GROUND
Up to 300mm (12")	900mm (3')
300mm - 600mm (12" - 24")	1100mm (3' 8")
600mm and bigger (24" plus)	1200mm (4')

Valves

- General Purpose Valve
- Air Valve
- Pressure Control Valve
- Customer Valve

Hydrants

- Single Hydrant

Meters

- Meter

End Items

Symbol indicating what happens at the end of a water main.

- Blank Flange
- Capped End
- Emptying Pit
- Undefined End
- Manifold
- Customer Supply
- Fire Supply

Operational Sites

- Booster Station
- Other
- Other (Proposed)
- Pumping Station
- Service Reservoir
- Shaft Inspection
- Treatment Works
- Unknown
- Water Tower

Other Symbols

- Data Logger
- **Casement:** Ducts may contain high voltage cables. Please check with Thames Water.

Other Water Pipes (Not Operated or Maintained by Thames Water)

Other Water Company Main: Occasionally other water company water pipes may overlap the border of our clean water coverage area. These mains are denoted in purple and in most cases have the owner of the pipe displayed along them.

Private Main: Indiates that the water main in question is not owned by Thames Water. These mains normally have text associated with them indicating the diameter and owner of the pipe.

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