2-4 RINGERS ROAD

London Borough of Bromley

OUTLINE SUSTAINABLE DRAINAGE ASSESSMENT

Ringers Road Properties Ltd

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WATER | ENVIRONMENT

Water Environment Limited
6 Coppergate Mews
103 Brighton Road
Surbiton
London
KT6 5NE

Tel: 020 8545 9720

www.WaterEnvironment.co.uk

This report was commissioned by Substantia Group on the behalf of Ringers Properties Ltd in October 2020 to develop a Sustainable Drainage Strategy for the proposed residential and commercial development at 2-4 Ringers Road and 5 Ethelbert Road in Bromley, London. The design and report were revised in April 2023 due to design changes with the proposed development.

Prepared by:	**Claire Burroughs** MSc DIC, MEng (Hons) MCIWEM	
Reviewed by:	**Laura Sleightholme** MSc DIC, BSc (Hons) Geol MCIWEM FGS	
Approved by:	**Guy Laister** MScEng BScEng (Civil) CEng CEnv C.WEM MCIWEM Director	*for and on behalf of Water Environment Limited*

Document Version History

Revision	Date	Comments	Author	Approver
A	16th July 2021	Revised Design and Updated Report	CB	GL
B	3rd August 2021	Update to Description Per Client's Request	CB	GL
C	4th August 2021	Update to NPPF Reference	CB	GL
D	20th September 2021	Revised drawings	CB	GL
E	21st April 2023	Updated SuDS design due to change in proposed design	CB	GL

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GLOSSARY

AOD	Above Ordnance Datum
BGL	Below Ground Level
BGS	British Geological Survey
DEFRA	Department for Environment Food and Rural Affairs
EA	Environment Agency
FEH	Flood Estimation Handbook
LBB	London Borough of Bromley
LLFA	Lead Local Flood Authority
NPPF	National Planning Policy Framework
PPG	Planning Practice Guide
SFRA	Strategic Flood Risk Assessment
SuDS	Sustainable Drainage Systems
SPZ	Source Protection Zone

EXECUTIVE SUMMARY

This report considers the management of surface water in relation to proposed development at 2-4 Ringers Road (which fronts Ringers Road and Ethelbert Road) and 5 Ethelbert Road in Bromley, London. The development proposals are for the demolition of existing buildings and construction of a mixed use development comprising residential units, ancillary residents' facilities (including co-working space) and commercial floor space (Use Class E) across two blocks, along with associated hard and soft landscaping, amenity spaces, cycle and refuse storage.

The site is underlain by geology of permeable Harwich Formation, which is highly likely to support infiltration-based Sustainable Drainage Systems (SuDS). No on-site ground investigation has been undertaken to confirm the composition beneath the site or the depth to groundwater. Nearby boreholes indicate the depth to groundwater is approximately 3.5 m below ground and therefore traditional infiltration devices should be practicable. Infiltration from broader devices such as permeable paving and from bioretention systems may also be possible.

The site is located in Source Protection Zone 1 (SPZ1). Under the Environment Agency's Approach to Groundwater Protection document, any SuDS which discharge to ground (other than clean roof water) are required to undertake a hydrogeological risk assessment to ensure the SuDS systems does not become a pathway for contaminates to the groundwater supply. No on-site ground investigation has been undertaken and, as such, an assessment cannot be undertaken at this time. This must be undertaken at detailed drainage design stages to ensure no detrimental effect on the groundwater body.

In developing an outline drainage strategy for the site, the sustainable drainage hierarchy and discharge hierarchy have been applied. There are no suitable surface waterbodies in proximity of the site. The recommended strategy includes the use of combination green/blue roofs across both proposed blocks, permeable paving with a lined gravel subbase with landscaping in the courtyard as part of a system which has a controlled discharge to the existing surface water sewer in Ringers Road or Ethelbert Road. In addition, it is recommended that bioretention areas and rain gardens are used within the landscaping to provide additional source control, as well as potential communal rainwater harvesting systems. The site is not suitable for open storage features due to spatial constraints.

Calculations show that it is possible to contain the 100 year return period rainfall event including an allowance for climate change (40%) within a combination green/blue roof system with a lined infiltration blanket in the courtyard to control the peak discharge rate to 5 l/s. This discharge rate has been approved by Thames Water. The calculations for the design presented conservatively ignore any contribution to re-use, storage and attenuation that could be provided by any rainwater harvesting and / or bio-retention systems.

The drainage system presented herein is designed not to flood in the 100 year return period event including an allowance for climate change of 40%.

Subject to the implementation of a suitable SuDS strategy within the parameters detailed in this report, the proposed development would have an overall positive impact on the risk of flooding in the area by reducing on-site and off-site flood risk.

The report sets out details of a potential SuDS strategy for the site and requirements for surface water management including maintenance. Full details of the surface and foul water drainage systems will be completed at detailed design stage. Detailed management and maintenance plans will be confirmed at this further stage, and the freeholder will be responsible for upholding them.

1 INTRODUCTION

General Information

1.1 This sustainable drainage assessment is carried out in relation to the site of proposed development at 2-4 Ringers Street in Bromley and 5 Ethelbert Road. The site falls within the planning jurisdiction of the London Borough of Bromley (LBB). The site is currently occupied by a number of properties and is predominantly hardstanding.

1.2 The development proposed at the site is for a residential scheme with two blocks, comprising of 108 units. Due to the number of units proposed, the development is classified as "Major Development", and as a result, an assessment is required to demonstrate that Sustainable Drainage Systems (SuDS) have been considered.

1.3 The Lead Local Flood Authority (LLFA) role for this site is fulfilled by the LBB which develops, and controls policy related to SuDS and surface water management which must be considered. This report is in accordance with the relevant LBB policies and guidance, and includes within the appendix, the LBB SuDS proforma.

Scope of Study

1.4 The main objectives of this study are to:

- Consider the pre- and post-development drainage schemes and calculate pre- and post-development run-off rates and volumes based on standard methodologies;
- Consider potential future climate change over the lifetime of the proposed development;
- Provide outline design for drainage system elements and appropriate connection locations;
- Consider the SuDS hierarchy and sustainable discharge hierarchy;
- Confirm future management and maintenance requirements for proposed SuDS elements; and
- Provide advice and guidance on the management of surface water run-off at the site to ensure the risk of surface water flooding on the site and on nearby sites does not increase following development.

2 SITE DESCRIPTION

Location

2.1 The proposed development site is located at 2-4 Ringers Road and 5 Ethelbert Road. The site fronts Ringers Road and Ethelbert Road. The area is located at the juxtaposition of the commercial area of Bromley and the start of the residential area. As a result, the density of residential development is relatively high, with local facilities mixed with housing. The position of the development is shown in Figure 1.

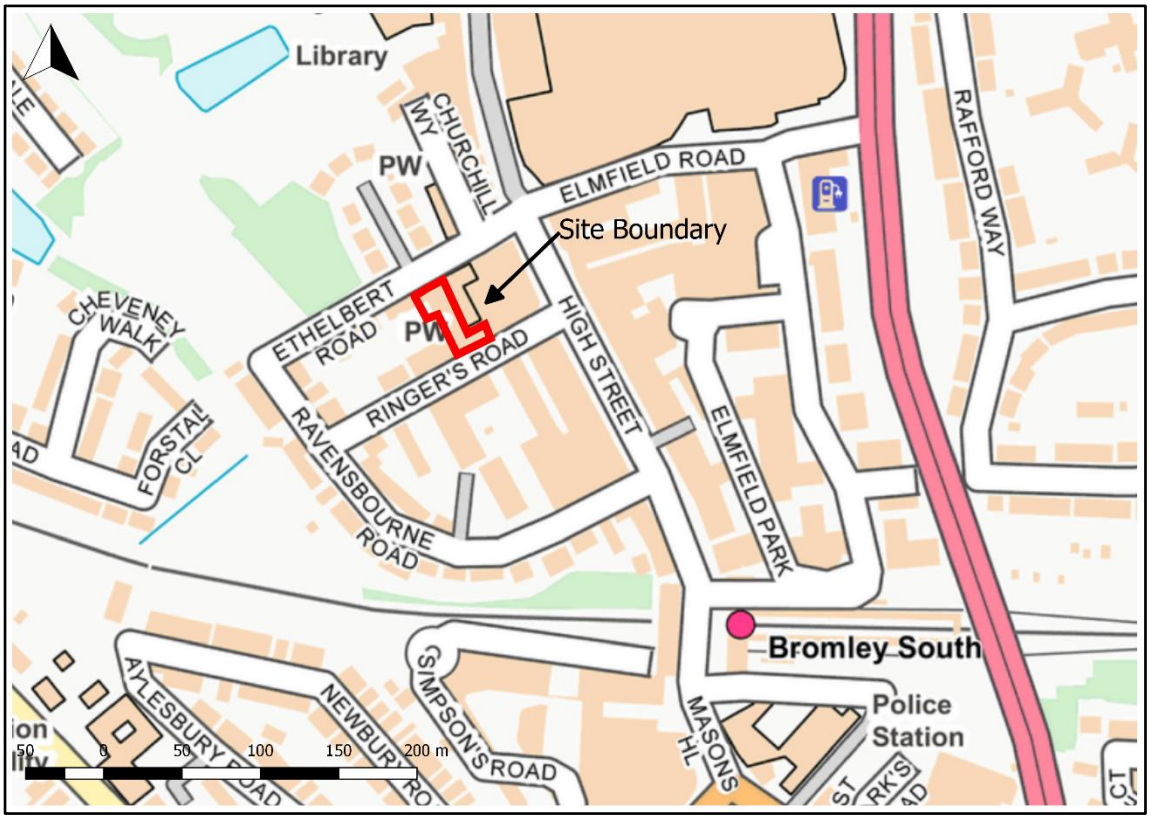


Figure 1 - Location of the development site[1]

Existing Development

2.2 A topographic survey of the site was undertaken by GM Surveys Limited in October 2020 and is included in Appendix A. The survey is referenced to the Ordnance Survey (OS) National Grid. The site slopes from north to south, with maximum levels of 57.59 m AOD on the northern boundary on Ethelbert Road, falling to 56.58m AOD on the southern boundary of the site on Ringers Road. There is also a slight fall from east to west with levels on Ethelbert Road being 300mm lower than on the eastern boundary compared to the western boundary.

2.3 The 0.108ha site is currently occupied by the commercial restaurant at 2-4 Ringers Road which extends to Ethelbert Road due to the associated annexes. The site also contains 5 Ethelbert Road.

[1] © Ordnance Survey Crown copyright. All rights reserved.
Licenced under http://www.nationalarchives.gov.uk/doc/open-government-licence/version/2/

2.4 The only permeable area on the site at present, is the rear garden of 5 Ethelbert Road which is roughly 150m^2. The rest of the site is impermeable hard-paved areas and roofs. The existing site is currently 86% impermeable.

2.5 There is limited evidence of existing formal surface water drainage infrastructure on the site, and the existing building does not have gutters or downpipes. There is a drainage channel noted within the rear garden of 5 Ethelbert Road and a number of manholes across the site. However, there is no indication of the presence or location of a surface water drainage run that serves the existing site(s).

Proposed Development

2.6 The proposed development is for the construction of a mixed use development comprising residential units, ancillary residents' facilities (including co-working space) and commercial floor space (Use Class E) across two blocks, along with associated hard and soft landscaping, amenity spaces, cycle and refuse storage.

2.7 The proposed development incorporates 94 residential units in the form of 1-2 bed apartments to be housed in two blocks. Block A is located on the southern side of the site, adjacent to Ringers Road and has 13 floors. Block B is located on the northern boundary and has 11 floors.

2.8 Both blocks have basements which accommodate bike storage, plant rooms, and co-working or event spaces.

2.9 The proposed development is classified as "More Vulnerable" to flood risk under the National Planning Policy Framework (NPPF). However, the site is located in Flood Zone 1 and not in any further areas of known flood risk and therefore the use is appropriate.

2.10 The proposed development incorporates soft landscaping areas including communal gardens. The communal gardens will include shallow rain gardens and raised planters. Both blocks have proposed green roofs.

3 PLANNING POLICY

National Planning Policy Framework

3.1 The National Planning Policy Framework (NPPF) was updated in July 2021[2] and sets out the Government's planning policies for England and how these are expected to be applied. The NPPF requires that "major development" incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate, as required by the House of Commons Written Statement (HCWS161) set down in December 2014. Paragraph 169 requires that all drainage systems should:

> *a) take account of advice from the lead local flood authority;*
> *b) have appropriate proposed minimum operational standards;*
> *c) have maintenance arrangements in place to ensure an acceptable standard of operation of the lifetime of the development; and*
> *d) where possible, provide multifunctional benefits.*

3.2 The accompanying Planning Practice Guidance (PPG) for Flood Risk and Coastal Change introduces the drainage discharge hierarchy (paragraph 56) which prioritises discharge of surface water to the ground and local watercourses over discharge to existing piped networks. The PPG requires consideration of the arrangements for maintenance of drainage systems, and refers ultimately to the Non-statutory Technical Standards for sustainable drainage systems[3] in providing the framework for SuDS design.

Non-statutory Technical Standards for Sustainable Drainage Systems

3.3 The NPPF requires the use of the Non-statutory Technical Standards for all drainage design related to "major development", except where it is "not reasonably practicable" to comply. The Technical Standards set out the required flow and volume restrictions, as well as requirements relating to flood risk, "so far as is reasonably practicable" as follows:

- Peak flows to drains or surface water bodies for the 1 year and 100 year return period rainfall events should never exceed the peak discharge rate prior to development, i.e. should not exceed greenfield peak flows for greenfield sites and should be as close as reasonably practicable to greenfield for previously developed sites.
- Total runoff volumes to drains or surface water bodies in the 100 year return period, 6 hour rainfall event should never exceed the runoff volume prior to development, i.e. should not exceed greenfield volumes for greenfield sites, and should be as close as reasonably practicable to greenfield for previously developed sites. In addition, where it is not possible to prevent additional volume leaving the site, additional volume must be discharged at a rate that does not affect flood risk.
- Unless specifically designed to hold or convey water above ground, drainage systems must be designed to contain below ground the 30 year return period rainfall event, to prevent any flooding of buildings or susceptible infrastructure in the 100 year return period rainfall event, and to provide exceedance routes for greater return period events that minimise the risks to people and property.
- The drainage system should be designed with sufficient structural integrity for the lifetime of the development for the anticipated loading conditions, should minimise the use of

[2] Ministry of Housing, Communities and Local Government (July 2021), updated National Planning Policy Framework
[3] Department for Environment, Food and Rural Affairs (March 2015), Sustainable Drainage Systems, Non-statutory technical standards for sustainable drainage systems

pumps, and should be constructed in such a way to avoid damage to existing drainage systems.

The London Plan

3.4 The site is located within Greater London and as such the development is subject to the requirements of the Mayor of London's strategic plan, 'The London Plan'. The London Plan is the overarching spatial strategy for the Greater London Area, and provides the basic foundation for planning policy in London.

3.5 The adopted London Plan[4] was published by the Mayor on the 3rd March 2021 following consultation between the Mayor of London and the Secretary of State in December 2020.

3.6 Sustainable drainage is considered in the current London Plan under Chapter 9 "Sustainable Infrastructure", and SI 13.

3.7 Policy SI 13; Sustainable Drainage states that:

> *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.*

3.8 Policy SI 13 also requires that "*impermeable surfacing should normally be resisted unless they can be shown to be unavoidable, including on small surfaces such as front gardens and driveways.*"

3.9 In addition, "*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".*

3.10 The promotion of SuDS is also mentioned in Policy G 5, Urban Greening and it is stated that:

> *"Major development proposals should contribute to the greening of London by including urban greening as a fundamental element of site and building design, and by incorporating measures such as high-quality landscaping (including trees), green roofs, green walls and nature-based sustainable drainage".*

[4] Mayor of London, March 2021, The London Plan, The Spatial Development Strategy for Greater London, Greater London Authority

Bromley Local Plan[5]

3.11 The site is located in the jurisdiction of the London Borough of Bromley (LBB). The Bromley Local Plan was adopted on 16th January 2019. The Local Plan sets out the planning policies, site allocations and land designations Borough-wide.

3.12 Policy 115 - Reducing Flood Risk requires collaboration between the Environment Agency, landowners and developers to manage and reduce flood risk from all sources, taking account of the most recent Council and other documents pertaining to local flood risk. The policy additionally states that the Council will apply the sequential and exception tests, will engage in emergency planning for all phases of flood events. The Council will require developers borough-wide to implement SuDS to manage surface water flood risk, and that all proposed flood risk mitigation measures be "effective, viable, attractive and enhance the public realm while ensuring that any residual risk can be safely managed".

Bromley Town Area Action Plan[6]

3.13 The Bromley Town Centre Area Action Plan (BTCAAP) was adopted in October 2010, and continues to be carried out as adopted policy with the exception of the limited policies and designations in the Local Plan which directly relate to the Bromley Town Centre. Under 'Sustainable Design and Construction' the APP 'promotes opportunities for water….' and 'Green roofs and surface water storage to reduce flood risk will be encouraged.' Policy BTC8 Sustainable Design and Construction requires a consideration of sustainable water use.

3.14 Policy BTC9-Flood Risk covers the requirements for flood risk in the action area. The key requirements relating to the proposed development include:

- An appropriate flood risk assessment is required in line with the SFRA and NPPF;
- Developments of over 500m^2 of floor space should reduce the risk of flooding from surface water and its contribution to fluvial flooding and incorporate appropriate flood resilience measures including raised ground floor levels as appropriate;
- Developments should seek to also reduce the risk of flooding from sewers and foul drainage; and
- Development layouts should consider the management of extreme flood events by assessing extreme and exceedance flood flow pathways.

3.15 Policy BTC11-Drainage covers the requirements for surface water drainage and requires that runoff rates from sites are limited to greenfield rates where possible for the 2 year, 30 year and 100 year event, or where this is not possible, to the appropriate London Plan standard.

3.16 Further specific requirements include the requirement to include the latest allowances for climate change across all return periods in drainage design, and to protect discharge to ground within source protection zones. The policy requires that no roof runoff be discharged into the existing surface water pipe network system.

[5] London Borough of Bromley (January 2019) Local Plan
[6] London Borough of Bromley (October 2010) Bromley Town Centre Area Action Plan

Strategic Flood Risk Assessment

3.17 The Strategic Flood Risk Assessment[7] (SFRA) covers the flood risks within the LBB and includes guidance on managing surface water for development.

3.18 The SFRA outlines SuDS principles and hierarchies which developers must adhere to, within their design.

3.19 The SFRA Appendix C is dedicated to SUDS. This document outlines the procedure developers should undertake to manage surface water runoff for proposed developments.

[7] AECOM, 20017, London Borough of Bromley Strategic Flood Risk Assessment

4 SURFACE WATER MANAGEMENT

Requirements

4.1 The LLFA is LBB and is currently responsible for consenting on SuDS, and the adopting drainage authority is Thames Water. The LBB SuDS proforma is appended to this report.

4.2 In accordance with the NPPF, surface water runoff rates and volumes should not increase as a result of the proposed development. LBB require major developments to reduce surface water rates post-development to the equivalent greenfield rate, through the use of SuDS wherever reasonably practicable.

4.3 Local planning policy also requires the design of drainage systems to follow both the SuDS hierarchy and the discharge hierarchy.

Ground Conditions

4.4 DEFRA Magic Maps[8] show the site to be in Source Protection Zone (SPZ) Zone 1. The purpose of SPZ are to provide protection to safeguard drinking water quality, and these are defined around large and public potable groundwater abstraction sites. SPZ1 is the inner zone and the highest value category.

4.5 SPZ1h is "*defined by a travel time of 50-days or less from any point within the zone at, or below, the water table. Additionally, the zone has as a minimum a 50-metre radius. It is based principally on biological decay criteria and is designed to protect against the transmission of toxic chemicals and water-borne disease*." It is therefore critically important the development does not impact or cause harm to the SPZ.

4.6 The DEFRA Magic Maps show the site is also overlies a Secondary A Aquifer and the area is at high risk of groundwater vulnerability. The mapping also notes the site is located within an area of soluble rock risk.

4.7 British Geological Survey (BGS) online maps shows the site to be underlain with a bedrock of Harwich Formation. No superficial deposits are recorded by BGS maps at the site.

4.8 Nearby BGS boreholes indicate the local area is located on a thin layer of made ground or clay followed by sand and gravels. The records are all consistent and BGS TQ46NW26 records groundwater being struck at 14' 0" (approx. 4.2m) and standing water settled at 11' 6" (aprox.3.5m) below ground level (BGL).

4.9 No ground investigation has been undertaken on the site and thus the exact depth of the groundwater is unknown.

4.10 The proposal for the site includes basements for both proposed blocks. The depth of the basement could therefore be similar to the groundwater level in the vicinity of the site. It is recommended that the development ensures the basement element of the scheme includes adequate waterproofing and dewatering techniques may be required during construction.

4.11 The desktop geology and groundwater study suggest that infiltration devices may be suitable for the site. A ground investigation with BRE365 rates would need to be undertaken to confirm that infiltration is possible and effective on the site. The ground investigation should also determine

[8] https://magic.defra.gov.uk/MagicMap.aspx

the depth of groundwater beneath the site to ensure a suitable depth between any infiltration devices and the recorded groundwater.

4.12 As the site is located in SPZ1, the Environment Agency's Approach to Groundwater Protection document requires all SuDS measures that discharge to ground (other than clean roof water) to undertake a hydrogeology risk assessment to ensure the SuDS systems does not become a pathway for contaminates or pollutants to the groundwater supply. As no on-site ground investigation has been undertaken to date, an assessment to determine that there is no risk of infiltration SuDS causing detrimental effect to the groundwater supply could not be undertaken. This assessment should be completed at detailed drainage design stage to confirm the acceptability of infiltration.

Site Runoff Rates

4.13 The 0.1078 ha site is currently formed mostly of impermeable surfaces, with the exception of an area of garden associated with 5 Ethelbert Road (155m^2). Rain falling on the entire site area is assumed to be collected and discharged into Ringers Road or Ethelbert Road. All calculated discharge rates for the site are presented in Table 1.

4.14 The present-day Greenfield peak runoff rate for the site area of 0.1078 ha was calculated using the IH124 methodology (UK SuDS greenfield calculation tool) to be 0.05 l/s in the 100 year return period event. The site has a SOIL type of 1, which equates to a percentage runoff (SPR) of 10%.

4.15 Although the survey suggests the presence of formal drainage on the site, there is no detail shown. It is therefore assumed that all surface water from impermeable surfaces currently discharges to Ringers Road or Ethelbert Road, either in formal infrastructure or overland.

4.16 Based on the topographic survey, the existing site is formed of 0.0925 ha impermeable surfaces, which is 86% of the existing site area. The existing site runoff was calculated using design rainfall intensities derived using the Wallingford Procedure[9]. The critical storm duration was estimated to be 9.0 minutes using parameters M5-60 of 20mm and an 'R' value of 0.40, and a site slope of 1 in 100. The time of concentration was determined via SCS Sheet Flow using a surface type of paving and shallow slope. The calculated peak runoff rate for the 100 year return period storm is 31.05 l/s.

4.17 The proposed site comprises of 0.0531 ha impermeable surfaces (49%), made up of roof area (non-green roof only), pathways, and patios. A green roof with an area of 531 m^2 (11%) and 428 m^2 (40%) of permeable / landscaped areas are proposed. The calculated peak runoff rate for the critical storm is 22.58 l/s in the 100 year return period event with the green roof. However, including an allowance for the impact of future climate change on storm intensities of 40%, this figure rises to 31.61 l/s with the green roof.

[9] HR Wallingford (2000) The Wallingford Procedure for Europe – Best Practice Guide to urban drainage modelling (CD)

Table 1 – Summary of Estimated Runoff Rates

Return Period:	Q_{bar}	1 year	30 year	100 year
Greenfield Runoff Rate (l/s) – IH124	0.02	0.01	0.04	0.05
Existing Runoff Rate (l/s)		10.33	24.94	31.85
Developed Runoff Rate (l/s) (with green roofs)		7.33	17.69	22.58
Developed Runoff Rate (+40%) (l/s) (with green roofs)		10.26	24.76	31.61

Discharge Hierarchy

4.18 The discharge hierarchy should also be considered, the Planning Practice Guidance states:

"Generally the aim should be to discharge surface runoff as high up the following hierarchy of drainage options as reasonably practicable:

1. *Into the ground (infiltration);*
2. *To a surface water body;*
3. *To a surface water sewer, highway drain or another drainage system;*
4. *To a combined sewer."*

4.19 Although the geology in the area is expected to be permeable based on local borehole logs, the layout of the development means that traditional infiltration devices such as soakaways are not suitable for the site due to Building Regulations Part H regarding stand off distances between soakaway and foundations. Shallow infiltration devices such as an infiltration blanket / gravel subbase are compatible with the proposals and Building Regulations Part H.

4.20 There are no surface water bodies within a reasonably practicable distance to use as an outfall location.

4.21 There is an existing Thames Water surface water sewer located in Ringers Road and Ethelbert Road, which will be used to discharge flows. It is assumed that surface water currently already discharges to this location, either through (unconfirmed) on-site drainage infrastructure, or overland.

Table 2 – Summary of Discharge Hierarchy

Outfall	Practicable	Proposed	Notes
Into the ground (infiltration)	✓	✓	Insufficient space for traditional discharge to ground, however infiltration will be promoted from permeable paved areas and bioretention areas.
To a surface water body	×	×	Distance to nearest waterbody is at least 250m through urban development. Cost would not be practicable.
To a surface water sewer, highway drain or another drainage system	✓	✓	Thames Water confirm connection in principle subject to comply with other policy.
To a combined sewer	×	×	Not required.

4.22 Thames Water were contacted for pre-application advice. The formal response confirmed that there is sufficient capacity to accept foul flows into the foul sewer network. In terms of surface water, the response emphasised the need to apply the discharge hierarchy, and to provide evidence to justify any discharge at greater than present-day greenfield rates, which for this site is less than 1 l/s in the 100 year event, whilst also considering the need to discharge at a sufficient rate to prevent blockage, consistent with a site where significant vegetation is proposed. The response confirmed that there is sufficient capacity in the surface water network to receive flows up to 5 l/s subject to the conditions applied above.

Sustainable Drainage Systems (SuDS) Hierarchy

4.23 The aim of SuDS is to emulate natural drainage processes such that watercourses and storage areas receive the hydrological profiles under which they evolved, and that water quality in local ecosystems is protected or improved. The best practice guide[10] states that SuDS will:

- Reduce the impact of additional urbanisation on the frequency and size of floods;
- Protect or enhance river and groundwater quality;
- Be sympathetic to the needs of the local environment and community; and
- Encourage natural groundwater recharge.

4.24 Figure 2 shows the hierarchy of SuDS techniques. The SuDS techniques that are proposed to manage surface water for the development will be discussed in relation to this hierarchy.

[10] CIRIA (2001), *CIRIA C523:* Sustainable Drainage Systems – Best practice.

	SUDS Technique	Flood Reduction	Pollution Reduction	Landscape & Wildlife
Most Sustainable	**Green roofs**	✓	✓	✓
	Basins and ponds 1. Constructed wetlands 2. Balancing ponds 3. Detention basins 4. Retention ponds	✓	✓	✓
	Filter strips and swales	✓	✓	✓
	Infiltration devices 5. Soakaways 6. Infiltration trenches and basins	✓	✓	✓
	Permeable surfaces and filter drains 7. Gravelled areas 8. Solid paving blocks 9. Porous paviors	✓	✓	
Least Sustainable	**Tanked systems** 10. Over-sized pipes/tanks 11. Box storage systems	✓		

Figure 2[11] – SuDS Hierarchy

4.25 Living roofs are feasible for the development due to the flat roof construction and therefore have been proposed in the design. Living roofs are compatible with photovoltaics. The presence of a living roof with photovoltaics benefits the performance of these devices due to providing an ambient micro-climate.

4.26 In order to provide source control and retain rainwater on site for reuse, it is strongly recommended that vegetated areas are designed as bioretention areas, tree pits and /or rain gardens to retain and utilise rainfall. Equally water buts could be implements to water the vegetated areas.

4.27 Since the development includes communal garden areas, rainwater harvesting systems could be employed to collect roof-water both for irrigation and / or non-potable water supply. Although it is strongly recommended that source control systems are utilised in the final site design, in a conservative approach to runoff calculation, rainwater harvesting systems were not considered within the calculations.

4.28 Basins, ponds, filter strips and swales are not suitable for use within the development due to a lack of available space.

4.29 Infiltration devices such as formal soakaways are not practicable due to there not being sufficient space on the site to allow a 5 m buffer between a soakaway and the proposed buildings including the basement. This is because Building Regulations Part H (Drainage and Waste Disposal) requires formal soakaways to be positioned at least 5 m away from foundations (including basements).

[11] http://www.sustainabledrainagecentre.co.uk/suds-hierarchy_c2236.aspx Retrieved 02/11/2016

4.30 Paved areas on the site, as per the London Plan, are proposed to be permeable. These permeable paved areas will attenuate flows, as well as filter rainwater to improve quality, within a porous sub-base.

4.31 Shallow infiltration devices are therefore suitable and can be located within proximity of buildings and foundations as long as the contributing area is no larger than the infiltration area

4.32 For an infiltration blanket to provide acceptable infiltration to ground, the base of the paving must extend beyond the depth of made ground that may be present on the site. If there are concerns regarding contamination of the made ground, the sides of the paving should be lined, and the basements tanked.

Table 3 – Summary of Proposed SuDS Relative to SuDS Hierarchy

SUDS Technique	Practicable	Proposed	Notes
Green roofs, Bioretention areas, Tree pits	✓	✓	Flat roof construction is suitable for green roofs. Bioretention areas and tree pits should be incorporated where possible.
Basins and ponds	×	×	Insufficient space available on the site.
Filter strips and swales	×	×	Insufficient space available on the site.
Infiltration devices	✓	✓	Insufficient distance from buildings and basements for traditional infiltration devices, however, permeable paving and bioretention areas should be unlined to allow infiltration where located a sufficient distance from buildings.
Permeable surfaces and filter drains	✓	✓	Permeable paving with sub-base storage is suitable for the site. Permeable paving proposed to reflect London Plan requirements.
Tanked systems	✓	✓	Required to ensure sufficient storage on the site to attenuate surface water prior to discharge into the Thames Water sewers.

Proposed Surface Water Drainage System

4.33 The design approach of integrating SuDS with the proposed development will be based on the SuDS and discharge hierarchies.

4.34 Infiltration via formal soakaway is not possible on the site due to not having sufficient distance from the proposed foundations and site boundary (as per Building Regulations Part H). However, shallow infiltration devices could be suitable.

4.35 Above ground attenuation of surface water is also not viable due to the small area of open space on the site.

4.36 To ensure a feasible SuDS design (using MicroDrainage), the following engineering decisions were made:

- Volumetric runoff coefficient (Cv) values were changed from the default (Cv=0.74 and 0.84) to ensure that all of the design storm event was captured in the drainage model. A Cv value of 1.0 ensures all of the storm is assessed i.e. 100% of the water. The default Cv values assume loss of water though natural infiltration etc.
- FEH (Flood Estimation Handbook) point data was also used for the storm event rather than FSR (Flood Studies Report). FEH is more up-to-date than FSR data and provides a more-reliable representation of the expected rainfall on the site.
- The precautionary assumptions and decision used (no bio retention, no water butts) within the SuDS calculations ensure there is adequate capacity in the network for the design storm event. This means there should be additional storage available within the proposed subbase for exceedance events, if additional SuDS features are implemented (such as water butts).

4.37 The proposed SuDS strategy therefore comprises the following components:

- Roof A combination blue/green roof (238 m²) + 107 m² impermeable roof area
- Roof B combination blue/green roof (294 m²) + 192 m² impermeable roof area
- permeable paving with infiltration blanket (126 m^3);
- permeable / landscaped areas (120 m^3); and
- discharge at a controlled rate to Thames Water sewer at 5 l/s.

4.38 The strategy was modelled using Microdrainage Source Control, the calculations presented herein are the worst-case scenario in terms of the required storage. The Microdrainage calculations are included within Appendix B.

4.39 The blue roofs were modelled as cellular storage with a depth of 165 mm and porosity of 90% below the green roofs. The depth and porosity of the cellular storage is based on the ACO Roofbloxx 165 product.

4.40 An online orifice flow control was set at the maximum level depth of the cellular storage/blue roofs.

4.41 For the remainder of the site, the hard surfacing (126 m^2) is to be permeable paved. A lined 250 mm gravel subbase with 30% porosity can attenuate surface water from the courtyard and other pathways around the site (including an additional 120 m² of landscaped areas).

4.42 The combined controlled outfall for the development is 5 l/s using a vortex flow control (ACO Q-Brake of similar).

4.43 The design is preliminary and demonstrates feasibility only, it should be revisited at detailed design stage to ensure all elements of the proposed scheme fall within the required design guidelines. As a result of the conservative assumptions used in this analysis, it is likely that the total volume of storage required will ultimately be less than concluded in this assessment.

4.44 The outline SuDS calculations has not included any bio-retention / water butts / rainwater harvesting areas within the courtyard. This is because these SuDS features could be full at the time of design storm and therefore no confirmation that these features could attenuate surface water at the time of a storm event. The inclusion of these features within the overall outline SuDS strategy means there is potential for additional storage of surface water on the site, above what has been modelled and presented in the Microdrainage Source Control calculations.

4.45 At the detailed design stage, the following considerations should be included:

- Full catchment and network modelling;
- Geotechnical investigations including BRE365 standard soakage testing to refine the design and extent of infiltration components;
- Inclusion of specialist design and detailed specification of green roof, blue roof, rainwater harvesting, bioretention areas, tree pits etc. within detailed network modelling;
- Detailed Quantity Surveyor input to determine financial implications of excavation related to permeable paving depth and extent, and potential partial replacement with crates, and/or refinement of discharge rate;
- Detailed specific management and maintenance plans and agreements;
- Exceedance routes diagram; and
- Final agreement with LBB and TW regarding SuDS approval and final consents (where applicable).

Drainage Exceedance

4.46 The SuDS strategy outlined above is designed to contain the 100 year return period rainfall including a 40% allowance for climate change. It is highly unlikely that this system would fail and cause flooding elsewhere. Total collection system failure would still result in lower discharge from the site in comparison with the existing scenario because of the presence of more storage on the site (green roof, blue roof, infiltration blanket and landscaping). Further, where multiple SuDS features are employed, such as green roofs, blue roof bioretention, the impact of failure of any one element is substantially reduced.

4.47 There is a very low chance of system exceedance in more severe events or successive extreme events, which is outside the scope of design. In this event, water would discharge via the site entrance onto either Ringers Road or Ethelbert Road depending on the gradients on the site post-development and follow natural drainage pathways into the highway gullies. This is the same as the existing mechanism, however, the volume of discharge in extreme events would be significantly reduced by the development as a result of the storage provided on site to attenuate the design event. Consequently, the severity of offsite flooding in these events would be substantially reduced by the proposed development.

Effect on Flood Risk Elsewhere

4.48 Due to the implementation of a suitable SuDS strategy, and by controlling the discharge rates from the site, the overall site discharge of surface water will reduce substantially following development. As a result, pressure on surface water collections systems will reduce.

4.49 The overall effect of the proposed SuDS strategy is a net reduction in flood risk at the site and in the local area.

SuDS Management and Maintenance

4.50 Management and maintenance of the drainage network, including the permeable surfacing and gravel sub-base will be the responsibility of the freeholder and / or management company for the site. Management and maintenance agreements and plans will be arranged prior to completion of development.

4.51 The SuDS Manual (CIRIA Guide) provides details for maintaining SuDS. Guidance on maintenance requirements for green roofs, permeable surfacing and bioretention systems (rain gardens) are presented in proceeding tables.

4.52 The CIRIA guidelines are generic and provide advice only. Management and maintenance of the drainage should be carried out in accordance with the guidance and specification provided by the supplier of each SuDS component.

Table 4 - Maintenance requirements for green roofs

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

Table 5 - Maintenance requirements for permeable block paving

Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, after autumn leaf fall, or reduced frequency as required)
Occasional Maintenance	Stabilise and mow contributing and adjacent areas	As required
	Removal of weeds	As required
Remedial Actions	Remediate any landscaping which, through vegetation maintenance or soil slip, has been raised to within 50mm of the level of the paving	As required
	Remedial work to any depressions, rutting and cracked of broken blocks considered detrimental to the structural performance or a hazard to users, and replace lost joining material	As required
	Rehabilitation of surface and upper substructure by remedial sweeping	Every 10 to 15 years or as required
Monitoring	Initial inspection	Monthly for three months after installation
	Inspect for evidence of poor operation and/or weed growth – if required, take remedial action	Three-monthly, 48h after large storms in first six months
	Inspect silt accumulation	Annually

Table 6 - Maintenance requirements for rain gardens (based on CIRIA C753 Table 18.3)

Maintenance Schedule	Required Action	Typical Frequency
Regular Inspections	Inspect infiltration surfaces for silting and ponding and assess standing water levels if appropriate	Quarterly
	Assess plants for disease infection, poor growth, invasive species etc and replace as necessary	Quarterly
Regular Maintenance	Remove litter and surface debris and weeds	At least Quarterly
	Replace plants to maintain planting density	As required
Occasional Maintenance	Infill any holes or depressions that develop within the sub-base	As required
	Repair accumulations of silt by raking surface mulch, scarifying and replacing mulch	As required
Remedial Actions	Remove and replace sub-base and filter medium, as well as replacing vegetation	As required, likely to be low frequency >20 years

Table 7 - Maintenance requirements for attenuation storage tanks (which reflects blue roofs)

Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action	Monthly for 3 months, then annually
	Remove debris from the catchment surface (where it may cause risk to performance)	Monthly
	For systems where rainfall infiltrates into the tank from above, check surface or filter for blockage by sediment, algae or other matter; remove and replace surface infiltration medium as necessary.	Annually
	Remove sediment from pre-treatment structures and/or internal forebays	Annually, or as required
Remedial Actions	Repair/rehabilitate inlets, outlets, overflows and vents	As required
Monitoring	Inspect/check all inlets, outlets, vents and overflows to ensure that they are in good condition and operating as designed	Annually
	Survey inside of tank for sediment build-up and remove if necessary	Every 5 years or as required

5 CONCLUSIONS AND RECOMMENDATIONS

5.1 The site is not at significant risk of flooding from any source. The development is classed as "major development", and therefore an assessment of drainage is required, together with a suitable strategy to reduce runoff rates in a sustainable manner, in order to reduce flood risk elsewhere.

5.2 The site is located in Source Protection Zone 1 (SPZ1) which requires, under the Environment Agency's Approach to Groundwater Protection document, that any SuDS which discharge to ground (other than clean roof water) to undertake a hydrogeology risk assessment to ensure the SuDS systems does not become an enabler of contaminates to the groundwater supply. No on-site ground investigation has been undertaken at this time. This should be completed at detailed drainage design stages.

5.3 By applying the SuDS and discharge hierarchies, it has been determined that the best strategy for surface water management is to discharge using a combination of interception (via green roofs), attenuation (blue roof) and bio-retention (via Silva cells) with a controlled discharge to the public sewer in Ringers Road or Ethelbert Road.

5.4 To provide a robust and conservative assessment, based on information available at this time, no infiltration was included in the outline SuDS design. As a result, the calculations presented herein are the worst-case scenario in terms of the required storage. The use of green roofs, blue roofs, permeable paving with a lined gravel subbase and landscaped areas were shown to be sufficient to reduce surface water rates to 5 l/s. The green roof provides some of the required attenuation storage, as well as filtering runoff with consequent benefits on water quality in line with Simple Index methods within the SuDS Manual.

5.5 The overall outline SuDS design presented in this report would prevent surface flooding in the 100 year return period rainfall event, including a 40% allowance for climate change.

5.6 Subject to detailed design, the proposed development would result in a net benefit by reducing the rates and volumes of runoff from the site, compared to the existing site. This would therefore the risk of flooding elsewhere. Associated benefits including improved quality of surface runoff, as well as biodiversity and habitat gains (from inclusion of green roofs and rain gardens) would result from the development.

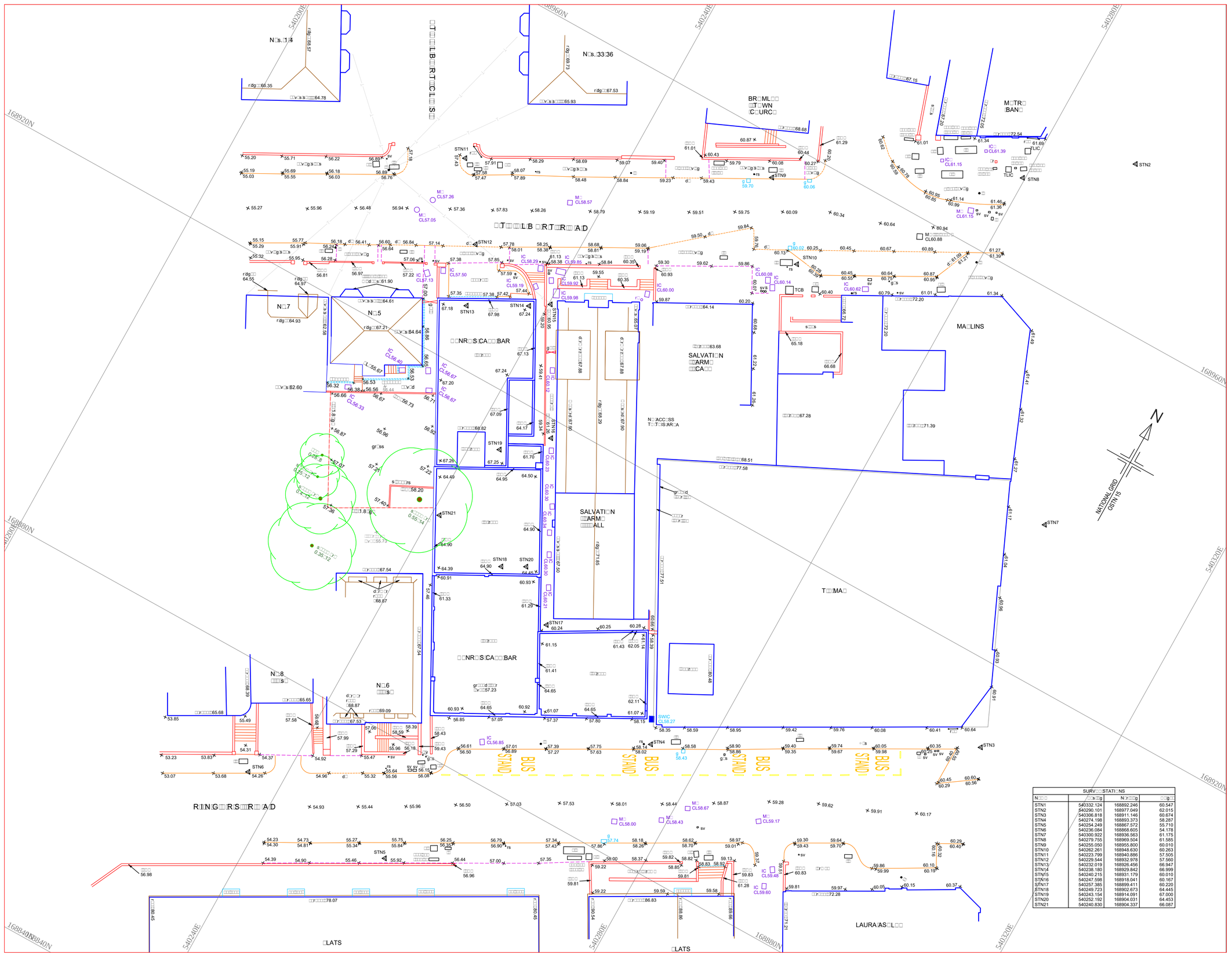
5.7 Management and maintenance of the drainage network, including the permeable surfacing and gravel sub-base would be the responsibility of the freeholder and / or management company for the site. Management and maintenance agreements and plans will be arranged prior to completion of development.

APPENDIX A - DRAWINGS

(1) Topographic Survey

(2) Proposed Site Plan including Landscaping

(3) SuDS Strategy Drawing



Legend

SERVICES & STREET FURNITURE

bo	bollard	lp	lamp post
BS	bus stop	MH	manhole
bu	bush	mk	marker
ctv	cable connection	pb	pillar box
cic	cable inspection cover	pi	pipe
CL	cover level	po	post
eic	electricity inspection cover	re	rodding eye
ep	power pole	rnp	road name/plate
er	earth rod	rs	road sign
fh	fire hydrant	rwp	rain water pipe
g	gully	sv	stop valve or other water meter
gv	gas valve	swp	sewer weir pipe
IC	inspection cover	TCB	telephone call box
IL	invert level	tic	telecom inspection cover
jb	junction box	TL	traffic light
ko	kerb outlet	tow	top of wall
LB	litter bin	tp	telegraph pole
		UTL	unable to lift

WALLS AND FENCES

c/b	closeboard fence	b/w	brick wall
ch/lk	chain link fence	b/bw	block wall
ch/plg	chestnut paling	c/ew	concrete wall
cor/ir	corrugated iron fence	ret/w	retaining wall
r/rlg	iron railings		
l/wp	larch lap fence		
o/b	open boarded fence		
p/w	post & wire fence		
p/r/f	post and rail fence		
p/c/h	post and chain fence		
w/msh	wire mesh fence		
w/v	woven fence		

BOUNDARY CONDITIONS

vg	very good	p	poor
g	good	b	bad
f	fair	vb	very bad

TREES

tree · bu bush · sap sapling

Trees are listed with species, trunk diameter and estimated height. Canopy spreads are shown graphically and are an average of the radius measured in the four cardinal directions. Where a canopy is grossly misshapen the symbol is distorted to represent this.

Please note that, while every care is taken, GM Surveys Ltd. do not accept responsibility for incorrect identification of trees. If trees are likely to have any effect over construction it is recommended that an Arboriculturalist is employed to confirm species and condition.

LINES / COLOURS

building
overhead canopy
roof line
25.0 contour line (1.0m intervals)
25.50 contour line (intermediate)
drainage line (foul)
drainage line (surface water)
drainage line (unidentified)
drainage line (surface water channel)
fence
wall
dk drop kerb
kerbline
road markings
top/bottom of bank
steps
change of surface
edge of foliage
hedge
overhead electric line
overhead telephone line

GRID AND LEVEL DATA

Survey grid related to OS National Grid (OSTN 15) and levels to OSGM 15.

Site centred on STN 1
Scale factor is 1.0000

GPS data captured using Trimble R8-2 GPS receiver.

DO NOT SCALE FROM THIS DRAWING

All dimensions should be verified on site and any discrepencies must be reported to GM Surveys immediately.

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SURV□□STATI□NS

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STN1	540332.124	168892.246	60.547
STN2	540290.101	168977.049	62.015
STN3	540306.818	168911.146	60.674
STN4	540274.198	168893.373	58.287
STN5	540254.249	168867.572	55.710
STN6	540236.084	168868.605	54.178
STN7	540300.922	168936.563	61.175
STN8	540279.755	168969.504	61.585
STN9	540255.050	168955.800	60.010
STN10	540262.261	168948.630	60.263
STN11	540223.799	168940.886	57.505
STN12	540229.544	168932.978	57.560
STN13	540232.019	168926.456	66.947
STN14	540238.180	168929.842	66.999
STN15	540240.215	168931.179	60.010
STN16	540247.598	168918.041	60.167
STN17	540257.385	168899.411	60.220
STN18	540249.723	168902.673	64.445
STN19	540243.154	168914.091	67.000
STN20	540252.192	168904.031	64.453
STN21	540240.830	168904.337	66.087

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GM SURVEYS LIMITED

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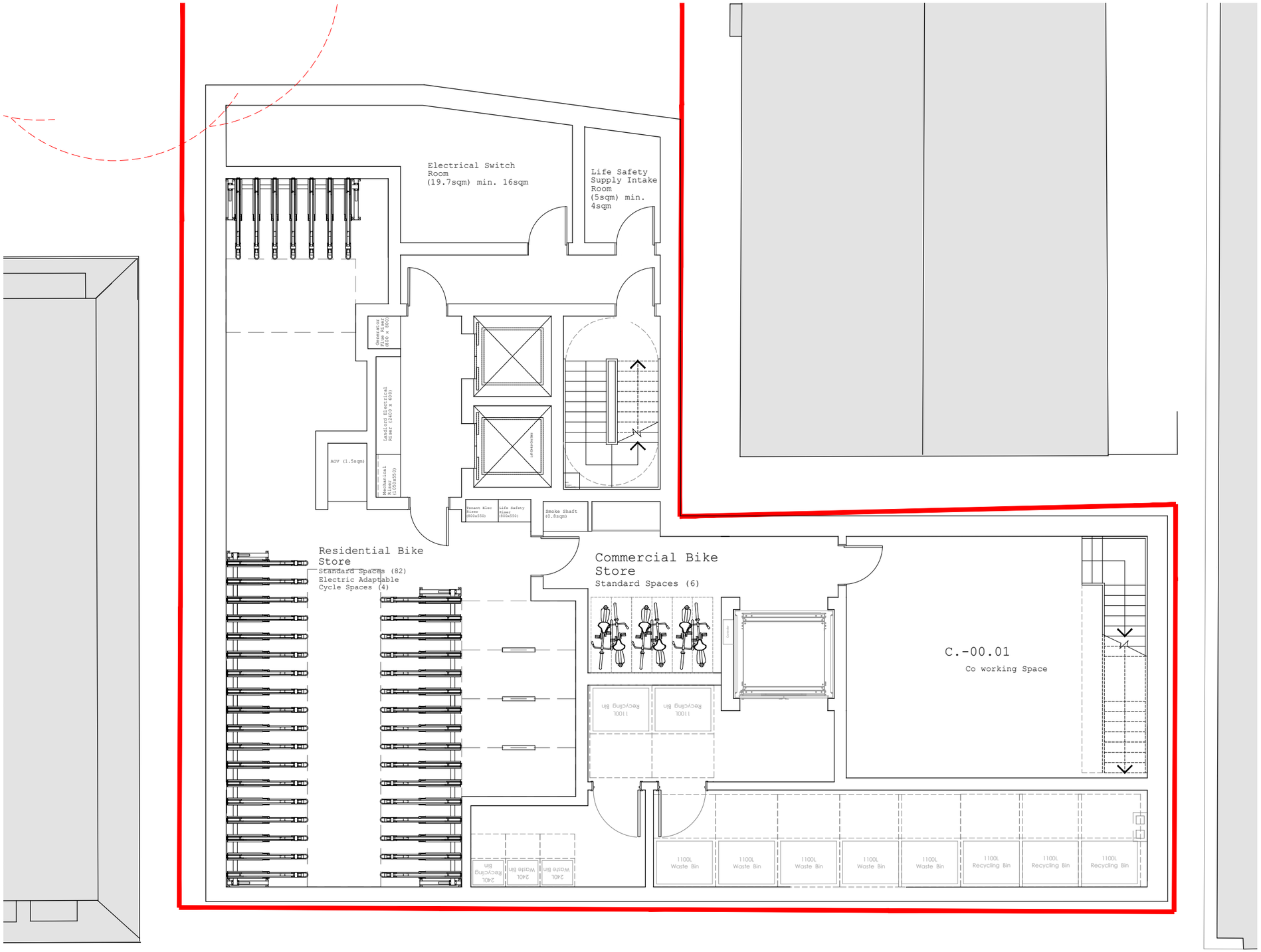

Site Boundary

Removed Trees

R2	General amendments following comments from fire consultant	LC	21.09.10
R3	Updates for Planning Submission	LC	27.10.2021
R4	Amendments following GLA Feedback	FW	30.09.2022
R5	Addition of 2nd Stairs	FW	03.02.2023
R6	Addition of 2nd Stair	OH	27.02.2023

N

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London | 10a Acton Street | London | WC1X 9NG
T +44 (0) 20 7096 5425 | E london@hollawaystudio.co.uk | W www.hollawaystudio.co.uk

Kent | The Tramway Stables | Rampart Road | Hythe | Kent | CT21 5BG
T +44 (0)1303 260 515 | E kent@hollawaystudio.co.uk | W www.hollawaystudio.co.uk

Project | Ringers Road
Bromley

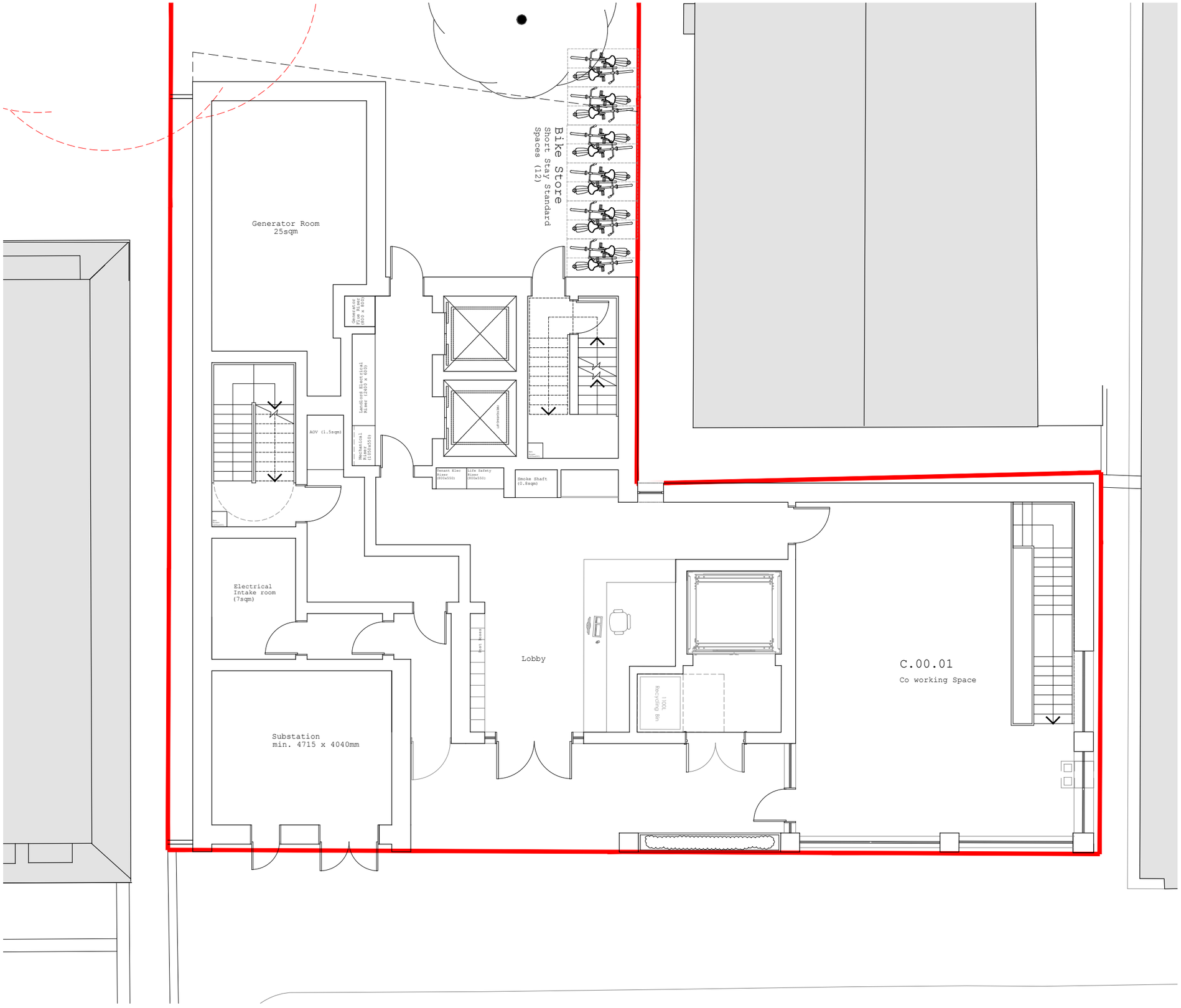
Client | The Substantia Group

Title | Proposed Lower Ground Floor - Block A

Status | PLANNING

Scale@A3 | 1:100 Date | 11.12.20 Drawn | FW Chk'd | TG

Project Number 18.085 Drawing Number 200.00 Revision R6



Site Boundary

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R2	Alterations to location of electrical intake room	LC	21.07.07
R3	General amendments following comments from fire consultant	LC	21.09.10
R4	Updates for Planning Submission	LC	27.10.2021
R5	Updates for Planning Submission	OH	20.01.2022
R6	Amendments following GLA Feedback	FW	30.09.2022
R7	Amendments to incorporate 'Generator Room'	PL	28.10.2022
R8	Addition of 2nd Stair	FW	27.02.2023

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Kent | The Tramway Stables | Rampart Road | Hythe | Kent | CT21 5BG
T +44 (01303 260 515 | E kent@hollawaystudio.co.uk | W www.hollawaystudio.co.uk

Project | Ringers Road
Bromley

Client | The Substantia Group

Title | Proposed Ground Floor - Block A

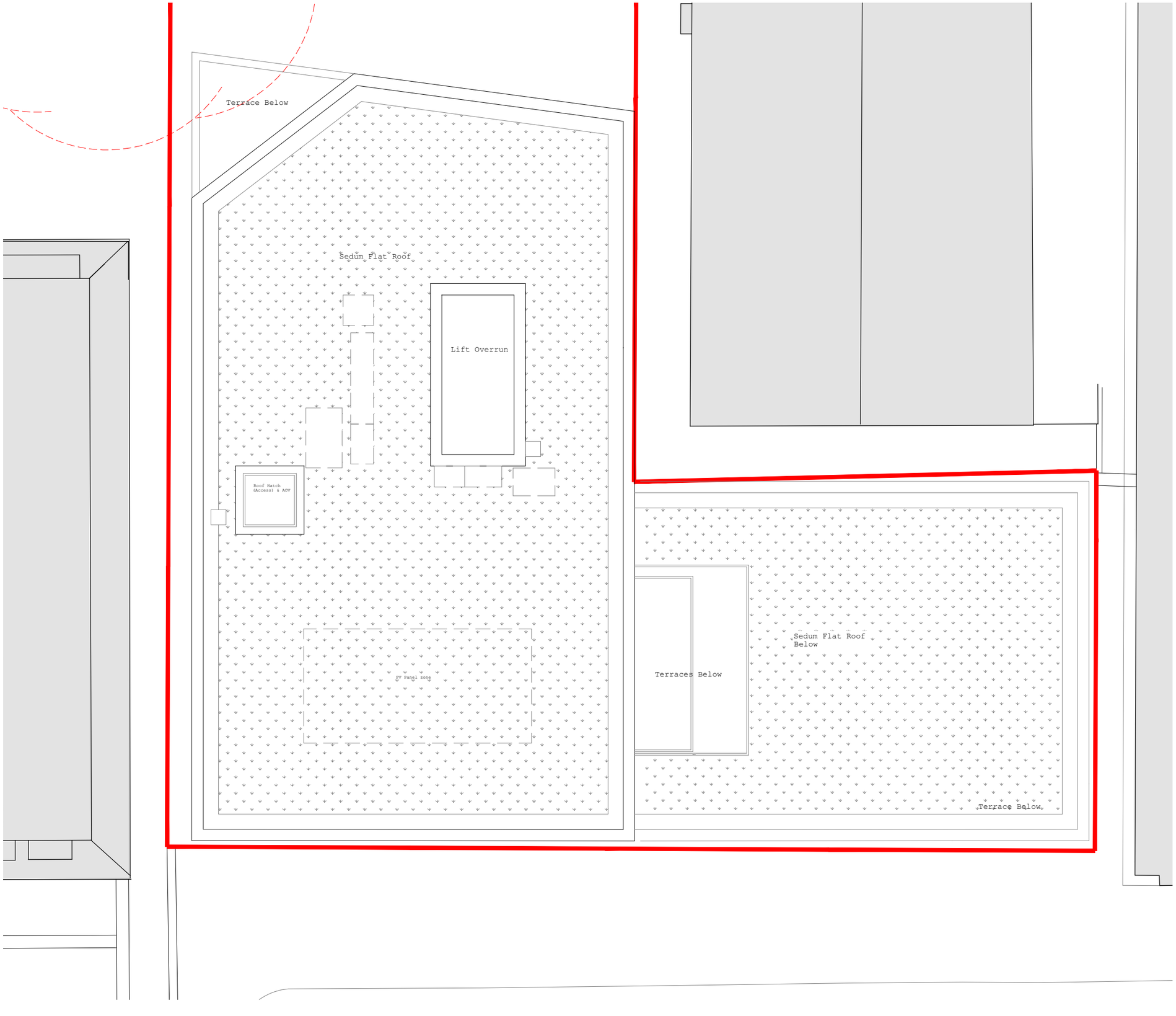
Status | PLANNING

Scale@A3 | 1:100 Date | 11.12.20 Drawn | GG Chk'd | LC

Project Number 18.085

Drawing Number 200.01

Revision R8



Site Boundary

Removed Trees

R2	General amendments following comments from fire consultant	LC	21.09.10
R3	Updates for Planning Submission	LC	27.10.2021
R4	Addition of 2nd Stair	OH	27.02.2023

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Kent | The Tramway Stables | Rampart Road | Hythe | Kent | CT21 5BG
T +44 (0)1303 240 515 | E kent@hollawaystudio.co.uk | W www.hollawaystudio.co.uk

Project | Ringers Road
Bromley

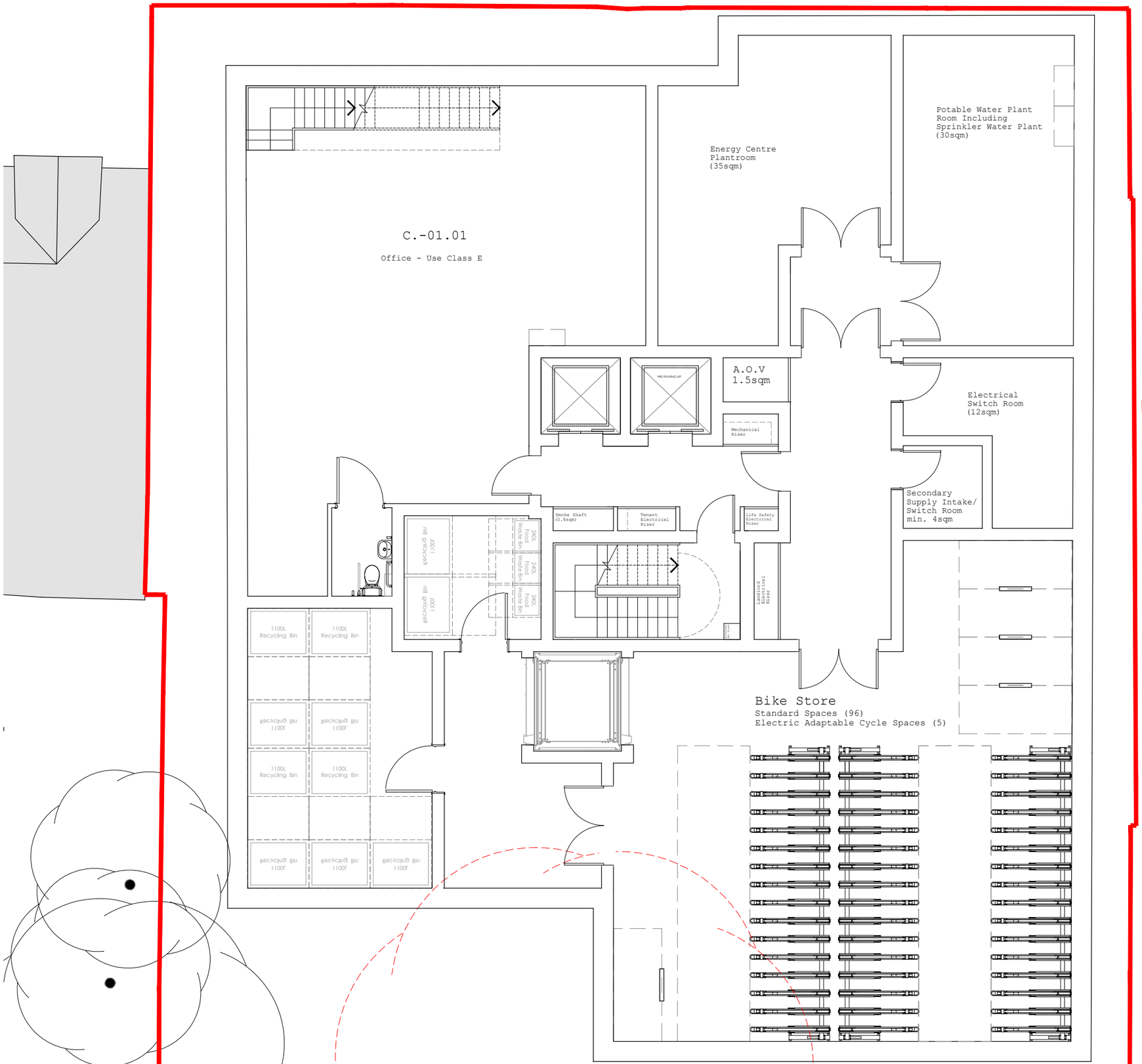
Client | The Substantia Group

Title | Proposed Roof Plan - Block A

Status | PLANNING

Scale@A3 | 1:100 **Date** | 11.12.20 **Drawn** | GG **Chk'd** | LC

Project Number 18.085 | Drawing Number 200.09 | Revision R4



Site Boundary

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R2	Alteration to Location of Intake/Switch Room	LC	21.07.07
R3	General amendments following comments from fire consultant	LC	21.09.10
R4	Updates for Planning Submission	LC	21.10.27
R5	Amendments following GLA Feedback	FW	22.10.03
R6	Addition of 2nd Stair	OH	23.02.23

N

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T +44 (0)1303 260 515 | E kent@hollawaystudio.co.uk | W www.hollawaystudio.co.uk

Project | Ringers Road
Bromley

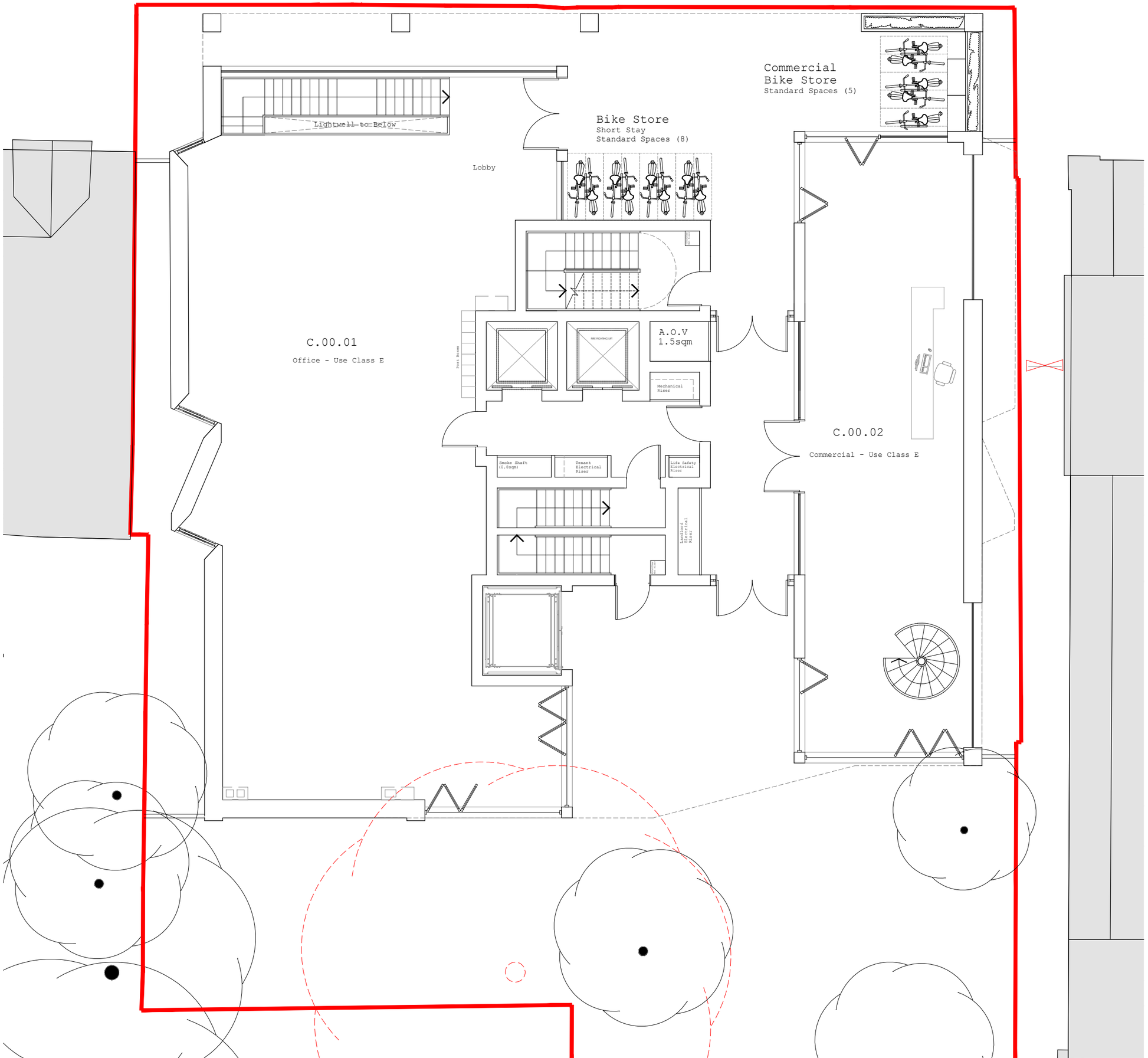
Client | The Substantia Group

Title | Proposed Lower Ground Floor - Block B

Status | PLANNING

Scale@A3 | 1:100 Date | 13.01.21 Drawn | GG Chk'd | LC

Project Number 18.085 | Drawing Number 210.00 | Revision R6



Site Boundary

Removed Trees

R2	General amendments following comments from fire consultant	LC	21.09.10
R3	Updates for Planning Submission	LC	21.10.27
R4	Updates for Planning Submission	OH	22.01.20
R5	Amendments following GLA Feedback	FW	22.10.03
R6	Addition of 2nd Stair	OH	23.02.23

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T +44 (0)1303 240 515 | E kent@hollawaystudio.co.uk | W www.hollawaystudio.co.uk

Project | Ringers Road
Bromley

Client | The Substantia Group

Title | Proposed Ground Floor - Block B

Status | PLANNING

Scale@A3 | 1:100 **Date** | 13.01.21 **Drawn** | GG **Chk'd** | LC

Project Number 18.085 | Drawing Number 210.01 | Revision R6

Sedum Flat Roof

Terraces Below

Sedum Flat Roof Below

Lift Overrun

ASHP Enclosure (40sqm)

Roof Hatch (Access) & AOV

TV IRS Aerial Array (2sqm)

Terraces Below

Site Boundary

Removed Trees

R2	General amendments following comments from fire consultant	LC	21.09.10
R3	Updates for Planning Submission	LC	21.10.27
R4	Update to Extent of Terrace for Planning Submission	OH	22.01.07
R5	Addition of 2nd Stair	OH	23.02.23

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Project | Ringers Road
Bromley

Client | The Substantia Group

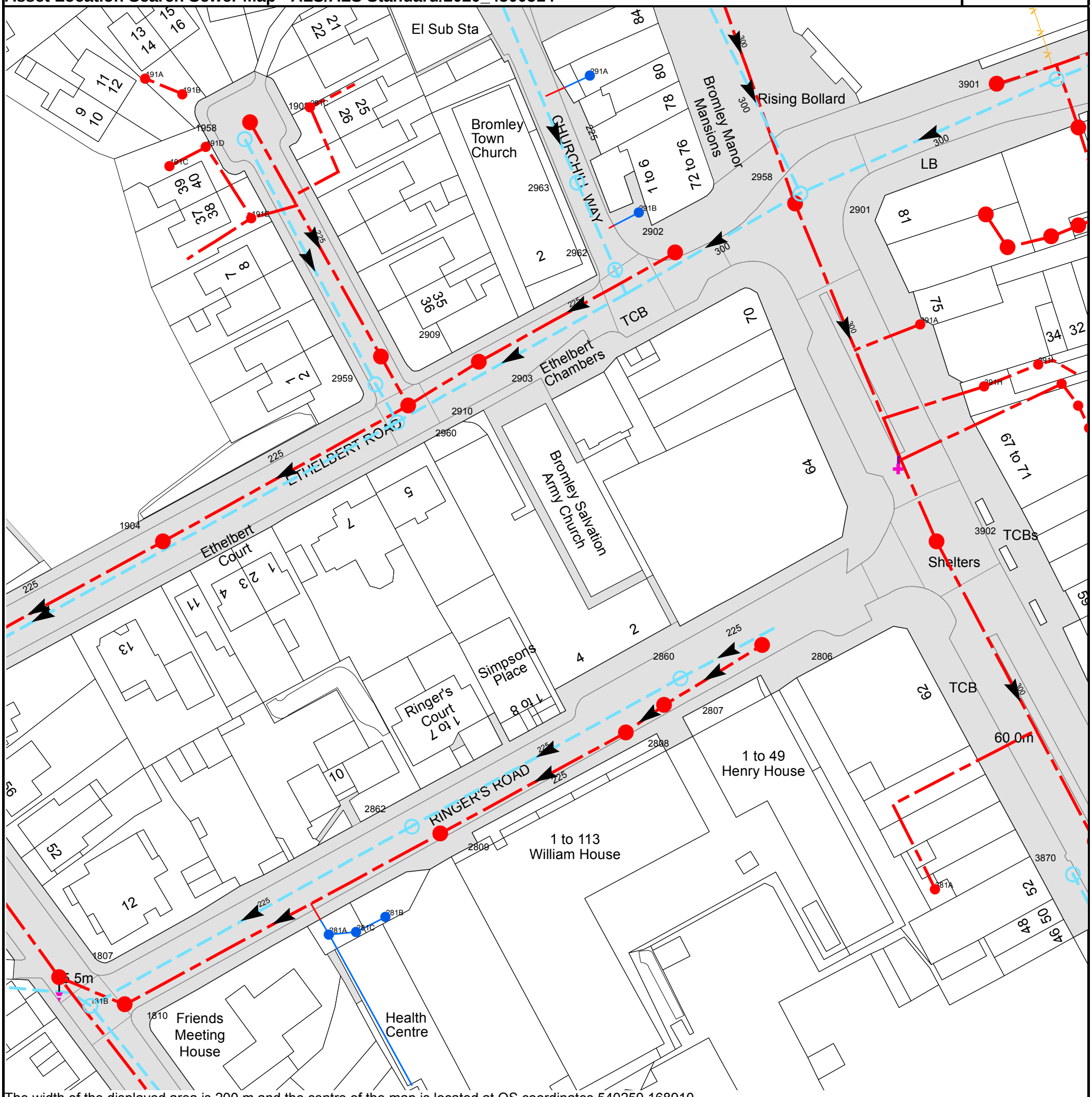
Title | Proposed Roof Plan - Block B

Status | PLANNING

Scale@A3 | 1:100 Date | 13.01.21 Drawn | GG Chk'd | LC

Project Number 18.085 | Drawing Number 210.07 | Revision R5

Asset Location Search Sewer Map - ALS/ALS Standard/2020_4300514



The width of the displayed area is 200 m and the centre of the map is located at OS coordinates 540250,168910

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
381A	n/a	n/a
3870	n/a	n/a
3803	59.7	56.52
2809	53.14	n/a
2862	52.7	n/a
2808	58.03	n/a
2807	58.46	n/a
2860	58.71	n/a
2806	59.24	n/a
3902	60.75	57.55
391F	n/a	n/a
181B	n/a	n/a
1810	n/a	n/a
1807	n/a	n/a
281A	n/a	n/a
281C	n/a	n/a
281B	n/a	n/a
1904	n/a	n/a
2960	n/a	n/a
2910	n/a	n/a
2959	n/a	n/a
2909	n/a	n/a
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3950	n/a	n/a
39LL	n/a	n/a
39KP	n/a	n/a
39KN	n/a	n/a
39LK	n/a	n/a
391H	n/a	n/a
391I	n/a	n/a
2903	n/a	n/a
391A	n/a	n/a
2962	60.37	58.06
2902	n/a	n/a
39KR	n/a	n/a
39KS	n/a	n/a
291B	n/a	n/a
2901	61.86	58.63
2958	n/a	n/a
2963	61.28	59.48
3901	n/a	n/a
291A	n/a	n/a
191E	n/a	n/a
191C	n/a	n/a
191D	n/a	n/a
1958	n/a	n/a
1908	n/a	n/a
291C	n/a	n/a
191B	n/a	n/a
191A	n/a	n/a

ALS Sewer Map Key

Public Sewer Types (Operated & Maintained by Thames Water)

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

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

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

Trunk Surface Water

Trunk Foul

Storm Relief

Trunk Combined

Vent Pipe

Bio-solids (Sludge)

Proposed Thames Surface Water Sewer

Proposed Thames Water Foul Sewer

Gallery

Foul Rising Main

Surface Water Rising Main

Combined Rising Main

Sludge Rising Main

Proposed Thames Water Rising Main

Vacuum

Sewer Fittings

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

Air Valve

Dam Chase

Fitting

Meter

Vent Column

Operational Controls

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

Control Valve

Drop Pipe

Ancillary

Weir

End Items

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

Outfall

Undefined End

Inlet

Other Symbols

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

Public/Private Pumping Station

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

Invert Level

Summit

Areas

Lines denoting areas of underground surveys, etc.

Agreement

Operational Site

Chamber

Tunnel

Conduit Bridge

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

Foul Sewer

Surface Water Sewer

Combined Sewer

Gulley

Culverted Watercourse

Proposed

Abandoned Sewer

Notes:

1) All levels associated with the plans are to Ordnance Datum Newlyn.
2) All measurements on the plans are metric.
3) Arrows (on gravity fed sewers) or flecks (on rising mains) indicate direction of flow.
4) Most private pipes are not shown on our plans, as in the past, this information has not been recorded.
5) 'na' or '0' on a manhole level indicates that data is unavailable.
6) The text appearing alongside a sewer line indicates the internal diameter of the pipe in milimetres. Text next to a manhole indicates the manhole reference number and should not be taken as a measurement. If you are unsure about any text or symbology present on the plan, please contact a member of Property Insight on 0845 070 9148.

Key:

Site Boundary

Urban Greening Factor				
Surface Cover Type		**Factor**	**Area (m²)**	**Contribution**
	Semi-natural vegetation (e.g. trees, woodland, species-rich grassland) maintained or established on site.	1	10.2	10.2
N/A	Wetland or open water (semi-natural; not chlorinated) maintained or established on site.	1	0	0
N/A	Intensive green roof or vegetation over structure. Substrate minimum settled depth of 150mm.	0.8	0	0
N/A	Standard trees planted in connected tree pits with a minimum soil volume equivalent to at least two thirds of the projected canopy area of the mature tree.	0.8	0	0
	Extensive green roof with substrate of minimum settled depth of 80mm (or 60mm beneath vegetation blanket) – meets the requirements of GRO Code 2014.	0.7	531.2	371.84
	Flower-rich perennial planting.	0.7	32.8	22.96
	Rain gardens and other vegetated sustainable drainage elements.	0.7	28.2	19.74
N/A	Hedges (line of mature shrubs one or two shrubs wide).	0.6	0	0
	Standard trees planted in pits with soil volumes less than two thirds of the projected canopy area of the mature tree.	0.6	58.9	35.34
	Green wall –modular system or climbers rooted in soil.	0.6	42.5	25.5
N/A	Groundcover planting.	0.5	0	0
	Amenity grassland (species-poor, regularly mown lawn).	0.4	42.7	17.08
N/A	Extensive green roof of sedum mat or other lightweight systems that do not meet GRO Code 2014.	0.3	0	0
	Water features (chlorinated) or unplanted detention basins.	0.2	1.9	0.38
	Permeable paving.	0.1	124.1	12.41
	Sealed surfaces (e.g. concrete, asphalt, waterproofing, stone).	0	304.1	0
	Total contribution		**515.45**	
	Total site area (m²)		1078.1	
	Urban Greening Factor		**0.478109637**	

UGF Roof Plan

1 : 100

Designed with reference to the surveys, information and reports listed:

0m 2m 4m 6m 8m

Rev	Date	Description
1	06/01/2022	Planning
2	05/04/2023	Planning

Dwn	Ckd
MG	DR
MG	DR

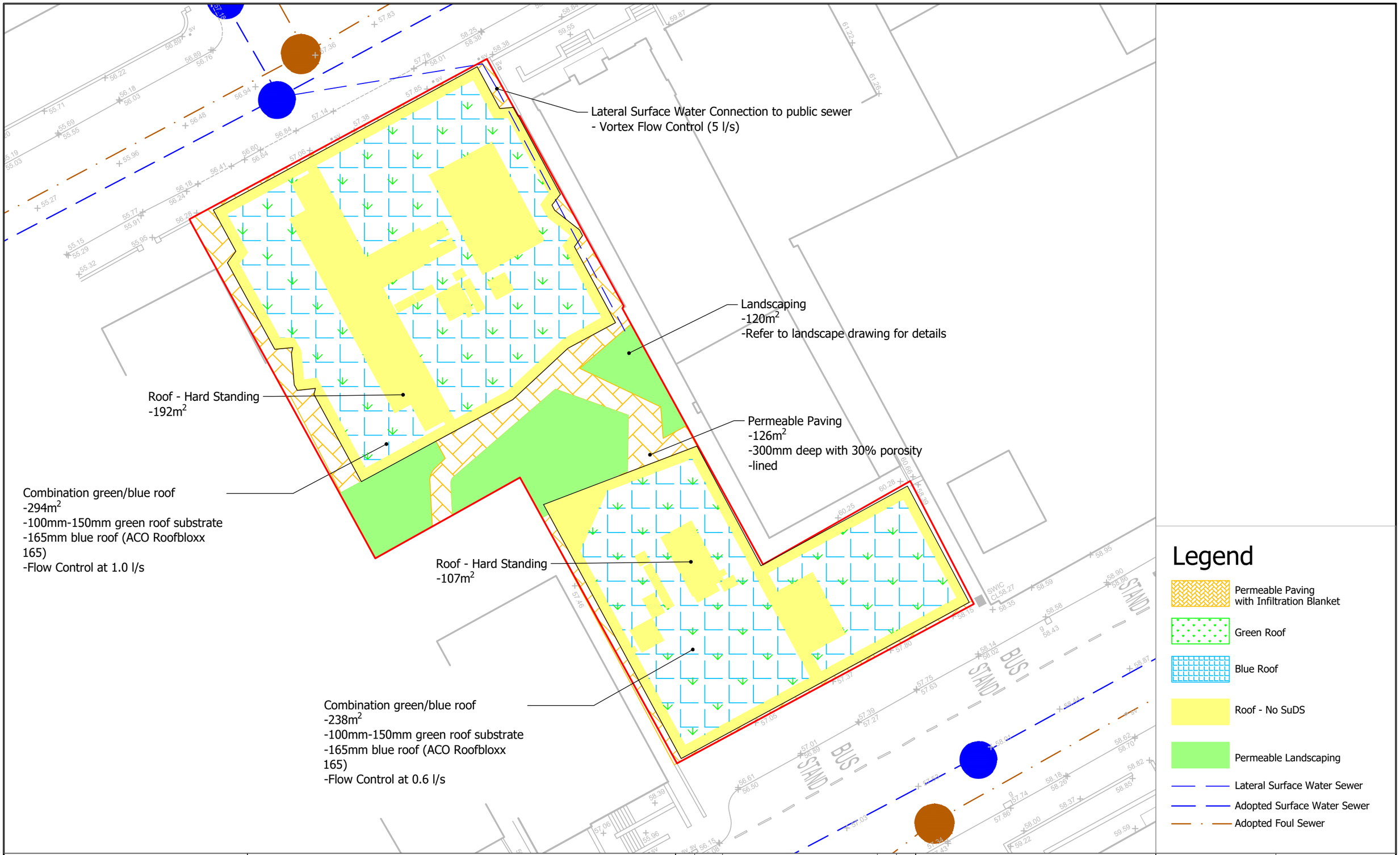
Drawn	MG
Checked	DR
Date	APRIL 2023
Scale @ A1	As indicated

Ringers Road

Urban Greening Factor

RNG-EDL-ZZ-XX-DR-L-0207 P2

edla



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NOTES
1. Dimensions in metres and levels in m AOD unless otherwise stated. Do not scale.
2. This drawing is for planning only, not for construction
3. Drawing to read with Water Environment SuDS Report Rev E
4. Site layout as per Hollaway Studio Drawing NO18.085 100.04 R3 and ETLA Drawing No RNG-EDL-ZZ-XX-DR-L-207_P2
5. Strategy based on Mircodrainge Source Control
6. All pipes shown as indicative
7. Thames Water asset details taken from Thames Water Asset Plan

REV	DATE	AMENDMENTS	DR	AP

CLIENT:	Ringer Road Properties Ltd
PROJECT:	2-4 Ringer Road
DRAWING:	Outline SuDS

SCALE @A3: 1:250	DATE: 14/04/23	
DRAWN: CB	CHECKED: GE	APPROVED: GL
DRAWING NO: 20108-SWD-PD-01	REVISION: C01	

APPENDIX B – SUPPORTING INFORMATION

(1) Surface Water Calculations

(2) Microdrainage Output

(4) LBB SuDS Proforma

(5) Thames Water Correspondence

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D21 RUNOFF CALCULATIONS | COVER SHEET

Job No.	20108	
Job Name	2-4 Ringers Road	
Engineer	Claire Burroughs	CB
Checked By	Gabriel Eve	GE
Date	20/04/2023	

Site Characteristics

Site Area (ha): 0.1078

	Overall		Discharging from site		
Existing Pervious Surfaces (ha)	0.0153	14%	0.0153	β	100%
Existing Impervious Surfaces (ha)	0.0925	86%	0.0925	α	100%
Total:	0.1078	Total:	0.1078		

	Overall		Discharging from site		
Proposed Pervious Surfaces (ha)	0.0119	11%	0.0119	β	100%
Proposed Impervious Surfaces (ha)	0.0428	40%	0.0428	α	100%
Proposed Green Roof	0.0531	49%	0.0531	γ	100%
Total:	0.1078	Total:	0.1078		

Green Roof Type: sedum-herbaceius-grass plants >10-15 cm Course Depth
Construction Depth: 100-150mm Gradient: of up to 15°,

Peak Rate of Runoff

Existing Site	BROWNFIELD
Detailed Modelling Used?	No e.g. Microdrainage, HydroCAD, Multiple Catchments
Runoff Calculation Method (Existing)	Wallingford/Modified Rational Calculation Sheets Attached
Runoff Calculation Method (Proposed)	Wallingford/Modified Rational Calculation Sheets Attached
Allowance for Future Climate Change	To 2115 UE 40%
Surface Water Management Strategy	Attenuated on Site

	1yr	30yr	100yr		
Existing Discharge Rate	**10.3**	**24.9**	**31.8**	l/s	
IoH Greenfield Discharge Rate (full site)	**0.0**	**0.0**	**0.1**	l/s	
Detailed modelling output/FEH:				l/s	
Limiting Discharge Rate	10.3	24.9	31.8	l/s	
Post-Development Discharge Rate	7.3	17.7	22.6	l/s	
Detailed modelling output:				l/s	
including allowance for climate change	**10.3**	**24.8**	**31.6**	l/s	
Proposed Discharge Rate	10.3	24.9	31.8	l/s	
Bespoke Limiting Discharge Rate	5.0	5.0	5.0		
Design discharge rate:	**5.0**	**5.0**	**5.0**	l/s	Bespoke Rate
Minimum Storage Required	**1.5**	**12.0**	**17.7**	m^3	

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IH124 : Greenfield Peak Runoff

20108	2-4 Ringers Road	
Calculations By: CB	Checked By: GE	Date: 20/04/2023

Catchment Area	AREA	ha	0.1078
Drained Area	AREA	ha	0.1078
Standard average annual rainfall 1941 - 1970	SAAR	mm	669
Soil Index (from FSR or Wallingford Procedure WRAP maps)*	SOIL		0.1

*SOIL is the SPR for the soil type, and for larger sites is a weighted sum of the individual soil classes for the site, where:

$$SOIL = \frac{0.1ASOIL1 + 0.3ASOIL2 + 0.37ASOIL3 + 0.47ASOIL5 + 0.53ASOIL5}{AREA}$$

For smaller sites, use the SPR for the local soil type, as follows:

SOIL TYPE	1	2	3	4	5
AREA	0.1078	0	0	0	0
SPR	0.1	0.3	0.37	0.47	0.53

SOIL: 0.1

$QBAR = 0.00108 . (0.01AREA)^{0.89}. SAAR^{1.17}. SOIL^{2.17}$

* The site area is less than 50ha. Since the IoH124 methodology is not calibrated for sites less than 50ha in area, the calculation should be undertaken based on a 50ha site area and proportionately adjusted based on the ratio of the site size to 50ha.

$QBAR_{50ha}$	l/s	7.97
QBAR/ha	l/s/ha	0.16
$QBAR_{site}$	l/s	**0.02**

Hydrological Area	fig 4.2	6

Return Period (years)	Growth Factor (table 4.3)	Discharge rate l/s
1	0.85	**0.01**
2	0.88	0.02
10	1.62	0.03
30	2.3	**0.04**
50	2.62	0.04
100	3.19	**0.05**

Figures and table references from CIRIA C753 The SUDS Manual © CIRIA 2015

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Wallingford Procedure : Existing Peak Runoff

20108	2-4 Ringers Road	
Calculations By: CB	Checked By: GE	Date: 20/04/2023

Site Characteristics

Site Area	AREA	ha	0.1078
Drained Catchment Area	AREA	ha	0.1078
Approximate Longest Drainage Path	L	m	100
Difference in Ground Levels	ΔH	m	1
Slope	Slope (S)		1: 100
Permeable Surfaces (Rational Method runoff coefficient = 0.4)		ha	14%
Impermeable Surfaces (Rational Method runoff coefficient = 0.95)		ha	86%
Area Weighted Rational Method Runoff Coefficient			0.872

Site parameters from The Wallingford Procedure for Europe: Best Practice Guide to urban drainage modelling, HR Wallingford, July 2000 (CD)

60minute, 5 year return period rainfall	M5-60	mm	20
Ratio of M5-60 to 2day, 5 year return period rainfall	r	-	0.40

Time of Concentration

Recommended Tc Method: SCS: Sheet Flow
Tc Method Choice: SCS: Sheet Flow

Sheet Flow

Surface Description			Paving or Brick
Slope			Shallow
Roughness Coefficient	(Manning's n)		0.018
Flow Length, L		m	100
M2-24hr		mm	37.70
Land Slope		m/m	0.01000
Tc		hr	0.15

Time of Concentration	T_c	min	9.0
Critical Storm Duration (minimum 5min)	T_{crit}	min	9.0

Critical Storm Rainfall and Runoff

$Z1_{TC}$	0.48	*Wallingford Procedure Figure 3.6
M5-T_{crit}	9.7	
C	0.872	

Discharge Rate
Q = 2.78CiA

Return Period (years)	Z2*	Depth (mm)	Intensity (mm/hr)	Discharge Rate l/s
1	0.61	5.9	39.5	**10.33**
2	0.79	7.7	51.0	13.34
10	1.21	11.8	78.4	20.49
30	1.48	14.3	95.4	**24.94**
50	1.63	15.8	105.4	27.55
100	1.89	18.3	121.8	**31.84**

*Wallingford Procedure Table 3.2

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Wallingford Procedure : Developed Peak Runoff

20108	2-4 Ringers Road	
Calculations By: CB	Checked By: GE	Date: 20/04/2023

Site Characteristics

Site Area	AREA	ha	0.1078
Drained Catchment Area	AREA	ha	0.1078
Approximate Longest Drainage Path	L	m	100
Difference in Ground Levels	ΔH	m	1
Slope	Slope (S)		1: 100
Permeable Surfaces (Rational Method runoff coefficient = 0.4)		ha	11%
Impermeable Surfaces (Rational Method runoff coefficient = 0.95)		ha	40%
Green Roof of gradient of up to 15°, and depth of 100-150mm , c=		0.4 *	49%
Area Weighted Rational Method Runoff Coefficient			0.62

*in line with Table 10.1 of CIRIA C644

Site parameters from The Wallingford Procedure for Europe: Best Practice Guide to urban drainage modelling, HR Wallingford, July 2000 (CD)

60minute, 5 year return period rainfall	M5-60	mm	20
Ratio of M5-60 to 2day, 5 year return period rainfall	r	-	0.40

Time of Concentration

Recommended Tc Method: SCS: Sheet Flow
Tc Method Choice: SCS: Sheet Flow

Sheet Flow

Surface Description			Paving or Brick
Slope			Shallow
Roughness Coefficient	(Manning's n)		0.018
Flow Length, L		m	100
M2-24hr		mm	37.70
Land Slope		m/m	0.01000
Tc		hr	0.15

Time of Concentration	T_c	min	9.0
Critical Storm Duration (minimum 5min)	T_{crit}	min	9.0

Critical Storm Rainfall and Runoff

$Z1_{TC}$	0.48	*Wallingford Procedure Figure 3.6
M5-T_{crit}	9.7	
C	0.618	

Discharge Rate
Q = 2.78CiA

Return Period (years)	Z2*	Depth (mm)	Intensity (mm/hr)	Discharge Rate l/s	Future Rate l/s
1	0.61	5.9	39.5	**7.33**	**10.26**
2	0.79	7.7	51.0	**9.46**	13.24
10	1.21	11.8	78.4	**14.53**	20.35
30	1.48	14.3	95.4	**17.69**	**24.76**
50	1.63	15.8	105.4	**19.54**	27.35
100	1.89	18.3	121.8	**22.58**	**31.61**

*Wallingford Procedure Table 3.2

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MRM 100 year Event Storage Calculator

20108	2-4 Ringers Road	
Calculations By: CB	Checked By: GE	Date: 20/04/2023

Site Parameters

Drained Catchment Area	AREA	ha	0.1078
Approximate Longest Drainage Path	L	m	100
Difference in Ground Levels	ΔH	m	1
Slope	Slope (S)		1: 100
Permeable Surfaces (Rational Method runoff coefficient = 0.4)		ha	11%
Impermeable Surfaces (Rational Method runoff coefficient = 0.95)		ha	40%
Green Roof of gradient of up to 15°, and depth of 100-150mm , c=		0.4 *	49%
Area Weighted Rational Method Runoff Coefficient			0.62

*in line with the FLL Guidelines on Planning, Execution and Upkeep of Green Roof Sites, 2002

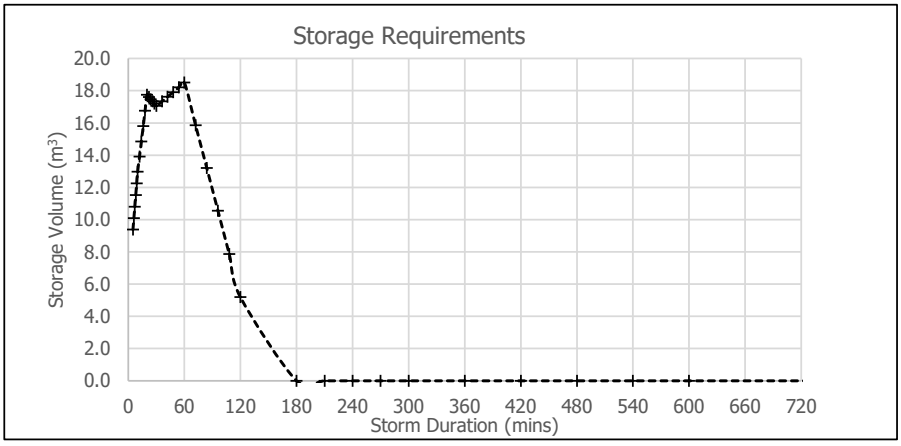
Site parameters from The Wallingford Procedure for Europe: Best Practice Guide to urban drainage modelling, HR Wallingford, July 2000 (CD)

60minute, 5 year return period rainfall	M5-60	mm	20
Ratio of M5-60 to 2day, 5 year return period rainfall	r	-	0.40
Time of Concentration	T_c	min	9.0

Maximum Storm Runoff Storage Volume (modified rational method)

	5	
T_d	20.0	min
$Z1_{TD}$	0.70	*Wallingford Procedure Figure 3.6
$M5\text{-}T_d$	14.0	mm
C	0.62	
$Z2_{100}$	1.97	*Wallingford Procedure Table 3.2
$M100\text{-}T_d$	27.6	mm
Intensity	82.9	mm/hr
Q_d	15.4	l/s
$Q_{d,climate\ change}$	21.5	l/s
$Q_{limiting\ discharge}$	5.0	l/s

Maximum storage required	m^3	17.7



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MRM 30 year Event Storage Calculator

20108	2-4 Ringers Road	
Calculations By: CB	Checked By: GE	Date: 20/04/2023

Site Parameters

Drained Catchment Area	AREA	ha	0.1078
Approximate Longest Drainage Path	L	m	100
Difference in Ground Levels	ΔH	m	1
Slope	Slope (S)		1: 100
Permeable Surfaces (Rational Method runoff coefficient = 0.4)		ha	11%
Impermeable Surfaces (Rational Method runoff coefficient = 0.95)		ha	40%
Green Roof of gradient of up to 15°, and depth of 100-150mm , c=		0.4 *	49%
Area Weighted Rational Method Runoff Coefficient			0.62

*in line with the FLL Guidelines on Planning, Execution and Upkeep of Green Roof Sites, 2002

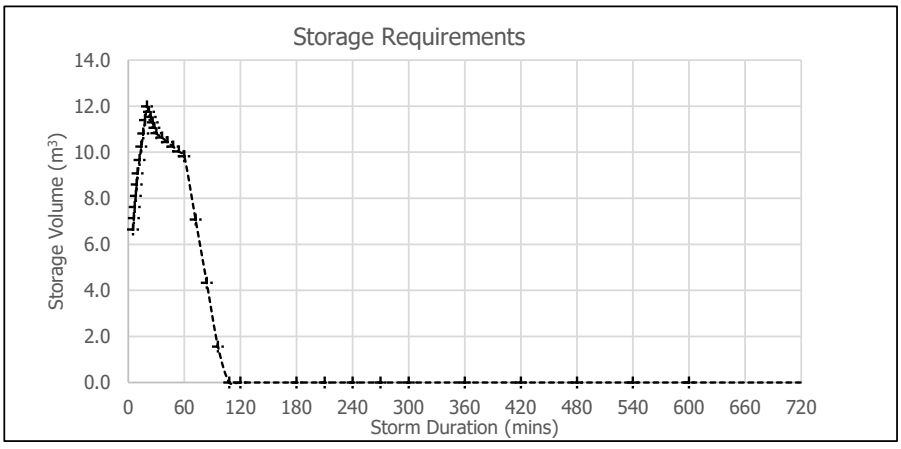
Site parameters from The Wallingford Procedure for Europe: Best Practice Guide to urban drainage modelling, HR Wallingford, July 2000 (CD)

60minute, 5 year return period rainfall	M5-60	mm	20
Ratio of M5-60 to 2day, 5 year return period rainfall	r	-	0.40
Time of Concentration	T_c	min	9.0

Maximum Storm Runoff Storage Volume (modified rational method)

T_d	20.0	min
$Z1_{TD}$	0.70	*Wallingford Procedure Figure 3.6
M5-T_d	14.0	mm
C	0.62	
$Z2_{30}$	1.52	*Wallingford Procedure Table 3.2
M30-T_d	21.3	mm
Intensity	63.8	mm/hr
Q_d	11.8	l/s
$Q_{d,climate\ change}$	16.6	l/s
$Q_{limiting\ discharge}$	5.0	l/s

Maximum storage required	m^3	12.0



Date Printed: 21/04/2023

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MRM 1 year Event Storage Calculator

20108	2-4 Ringers Road	
	Calculations By: CB	Checked By: GE	Date: 20/04/2023

Site Parameters

Drained Catchment Area	AREA	ha	0.1078
Approximate Longest Drainage Path	L	m	100
Difference in Ground Levels	ΔH	m	1
Slope	Slope (S)		1: 100
Permeable Surfaces (Rational Method runoff coefficient = 0.4)		ha	11%
Impermeable Surfaces (Rational Method runoff coefficient = 0.95)		ha	40%
Green Roof of gradient of up to 15°, and depth of 100-150mm , c=		0.4 *	49%
Area Weighted Rational Method Runoff Coefficient			0.62

*in line with the FLL Guidelines on Planning, Execution and Upkeep of Green Roof Sites, 2002

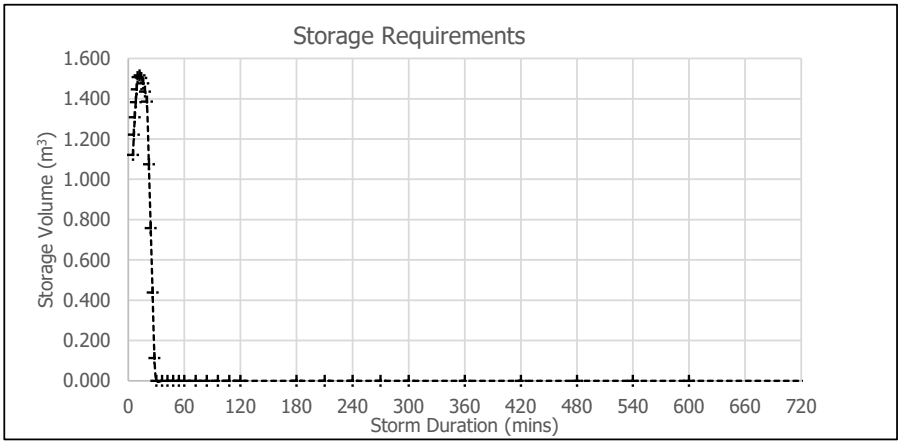
Site parameters from The Wallingford Procedure for Europe: Best Practice Guide to urban drainage modelling, HR Wallingford, July 2000 (CD)

60minute, 5 year return period rainfall	M5-60	mm	20
Ratio of M5-60 to 2day, 5 year return period rainfall	r	-	0.40
Time of Concentration	T_c	min	9.0

Maximum Storm Runoff Storage Volume (modified rational method)

T_d	11.7	min
$Z1_{TD}$	0.54	*Wallingford Procedure Figure 3.6
M5-T_d	10.9	mm
C	0.62	
$Z2_1$	0.61	*Wallingford Procedure Table 3.2
M1-T_d	6.6	mm
Intensity	34.0	mm/hr
Q_d	6.3	l/s
$Q_{d,climate\ change}$	8.8	l/s
$Q_{limiting\ discharge}$	5.0	l/s

Maximum storage required	m^3	1.5



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SUDS Manual Volume Calculation (Existing)

20108	2-4 Ringers Road	
Calculations By: CB	Checked By: GE	Date: 20/04/2023

Site Characteristics

Site Area	AREA	ha	0.1078
Permeable Surfaces (Existing Case)			14%
Proportion discharging to sewer network or local watercourses	β		100%
*zero if all runoff collected from unpaved surfaces is retained on site or discharged to ground			
Impermeable Surfaces (Existing Case)	PIMP		86%
Proportion discharging to sewer network or local watercourses	α		100%
*zero if all runoff from paved surfaces remains on site or is collected and discharged to ground			
Soil Index (from FSR or Wallingford Procedure WRAP maps)*	SOIL		0.1

*SOIL is the SPR for the soil type, and for larger sites is a weighted sum of the individual soil classes for the site, where:

$$SOIL = \frac{0.1A_{SOIL1} + 0.3A_{SOIL2} + 0.37A_{SOIL3} + 0.47A_{SOIL4} + 0.53A_{SOIL5}}{AREA}$$

For smaller sites, use the SPR for the local soil type, as follows:

SOIL TYPE	1	2	3	4	5	
AREA	0.1078	0	0	0	0	**SOIL:**
SPR	0.1	0.3	0.37	0.47	0.53	**0.1**

Site parameters from The Wallingford Procedure for Europe: Best Practice Guide to urban drainage modelling, HR Wallingford, July 2000 (CD)

60minute, 5 year return period rainfall	M5-60	mm	20
Ratio of M5-60 to 2day, 5 year return period rainfall	r	-	0.40

Volume Calculation for the 100 year return period 6hr storm

$Z1_{6hr}$	1.55	*Wallingford Procedure Figure 3.6
M5-6hr	31.1	
$Z2_{100yr}$	1.97	*Wallingford Procedure Table 3.2
M100-6hr	61.2	

Additional volume (m^3) of existing site runoff over Greenfield runoff:

$$Vol = \text{"M100-6hr"}.AREA.10[PIMP/100\ (0.8\alpha)+(1-PIMP/100)SOIL\ .\ \beta-SOIL]$$

* EQ24.10 CIRIA C753 The SUDS Manual © CIRIA 2015

Additional Volume of Runoff (above Greenfield state):	**m^3**	**39.6**

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SUDS Manual Volume Calculation (Developed)

20108	2-4 Ringers Road	
Calculations By: CB	Checked By: GE	Date: 20/04/2023

Site Characteristics

Catchment Area	AREA	ha	0.1078
Permeable Surfaces (Proposed Case)	PGF		11%
Areas discharging to soakaway or prevented from leaving site via mitigation		ha	0
	β		100%
Impermeable Surfaces (Proposed Case)	PIMP		40%
Areas discharging to soakaway or prevented from leaving site via mitigation		ha	0
	α		100%
Green Roof Area (Proposed Case)	PGR	Depth of Green Roof	49%
Annual coefficient of discharge*	ψ_a	>10-15 cm	0.45

**Inline with Table 3 of the FLL Planning, Execution and Upkeep of Green-roof sites, 2002*

Soil Index (from FSR or Wallingford Procedure WRAP maps)*	SOIL	0.1

*SOIL is the SPR for the soil type, and for larger sites is a weighted sum of the individual soil classes for the site, where:

$$SOIL = \frac{0.1A_{SOIL1} + 0.3A_{SOIL2} + 0.37A_{SOIL3} + 0.47A_{SOIL4} + 0.53A_{SOIL5}}{AREA}$$

For smaller sites, use the SPR for the local soil type, as follows:

SOIL TYPE	1	2	3	4	5	
AREA	0.1078	0	0	0	0	**SOIL:**
SPR	0.1	0.3	0.37	0.47	0.53	**0.1**

Site parameters from The Wallingford Procedure for Europe: Best Practice Guide to urban drainage modelling, HR Wallingford, July 2000 (CD)

60minute, 5 year return period rainfall	M5-60	mm	20
Ratio of M5-60 to 2day, 5 year return period rainfall	r	-	0.40

Volume Calculation for the 100 year return period 6hr storm

$Z1_{6hr}$	1.55	*Wallingford Procedure Figure 3.6
M5-6hr	31.1	
$Z2_{100yr}$	1.97	*Wallingford Procedure Table 3.2
M100-6hr	61.2	
With Climate Change	85.7	40%

Additional volume (m^3) of development runoff over Greenfield runoff:

$$Vol = \text{"M100-6hr"}.AREA.10[PIMP/100\ (0.8\alpha) + (\text{PGF}/100)SOIL\ .\ \beta + (\text{PGR}/100)\ .\ \Psi a - SOIL]$$

* Modified from EQ24.10 CIRIA C753 The SUDS Manual © CIRIA 2015

Additional Volume of Runoff (above Greenfield state) leaving the site:	m^3	41.6
Rainwater harvesting or other re-use scheme committed volumes:	m^3	0
Additional Volume of Runoff (above Greenfield state) leaving the site:	**m^3**	**41.6**

Online Controls for Storm

Orifice Manhole: 1, DS/PN: 1.001, Volume (m³): 1.2

Diameter (m) 0.027 Discharge Coefficient 0.600 Invert Level (m) 58.220

Orifice Manhole: 4, DS/PN: 2.001, Volume (m³): 1.2

Diameter (m) 0.035 Discharge Coefficient 0.600 Invert Level (m) 58.220

ACO Q-Brake Manhole: 2, DS/PN: 1.002, Volume (m³): 2.0

Design Head (m) 0.400 Diameter (mm) 109
Design Flow (l/s) 5.0 Invert Level (m) 55.720

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.1	1.200	8.6	3.000	13.6	7.000	20.7
0.200	4.9	1.400	9.3	3.500	14.7	7.500	21.5
0.300	4.9	1.600	9.9	4.000	15.7	8.000	22.2
0.400	5.0	1.800	10.5	4.500	16.6	8.500	22.8
0.500	5.5	2.000	11.1	5.000	17.5	9.000	23.5
0.600	6.1	2.200	11.6	5.500	18.4	9.500	24.2
0.800	7.0	2.400	12.1	6.000	19.2		
1.000	7.8	2.600	12.6	6.500	20.0		

Storage Structures for Storm

Cellular Storage Manhole: 1, DS/PN: 1.001

Invert Level (m) 58.220 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.90
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	238.0	0.0	0.166	0.0	0.0
0.165	238.0	0.0			

Cellular Storage Manhole: 4, DS/PN: 2.001

Invert Level (m) 58.220 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.90
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	294.0	0.0	0.166	0.0	0.0
0.165	294.0	0.0			

Porous Car Park Manhole: 2, DS/PN: 1.002

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	10.0
Membrane Percolation (mm/hr)	1000	Length (m)	12.0
Max Percolation (l/s)	33.3	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	55.720	Cap Volume Depth (m)	0.250

Time Area Diagram for Green Roof at Pipe Number 1.001 (Storm)

Area (m³) 238 Evaporation (mm/day) 3
Depression Storage (mm) 5 Decay Coefficient 0.050

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.004325	28	32	0.001067	56	60	0.000263	84	88	0.000065
4	8	0.003541	32	36	0.000873	60	64	0.000215	88	92	0.000053
8	12	0.002899	36	40	0.000715	64	68	0.000176	92	96	0.000043
12	16	0.002374	40	44	0.000585	68	72	0.000144	96	100	0.000036
16	20	0.001943	44	48	0.000479	72	76	0.000118	100	104	0.000029
20	24	0.001591	48	52	0.000392	76	80	0.000097	104	108	0.000024
24	28	0.001303	52	56	0.000321	80	84	0.000079	108	112	0.000020

Time Area Diagram for Green Roof at Pipe Number 1.001 (Storm)

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
112	116	0.000016	116	120	0.000013						

Time Area Diagram at Pipe Number 1.001 for Storm

Total Area (ha) 0.011

Time From:	(mins) To:	Area (ha)
0	4	0.011

Time Area Diagram for Green Roof at Pipe Number 2.001 (Storm)

Area (m³) 294 Evaporation (mm/day) 3
Depression Storage (mm) 5 Decay Coefficient 0.050

Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)	Time From:	(mins) To:	Area (ha)
0	4	0.005343	32	36	0.001079	64	68	0.000218	96	100	0.000044
4	8	0.004374	36	40	0.000883	68	72	0.000178	100	104	0.000036
8	12	0.003581	40	44	0.000723	72	76	0.000146	104	108	0.000029
12	16	0.002932	44	48	0.000592	76	80	0.000120	108	112	0.000024
16	20	0.002401	48	52	0.000485	80	84	0.000098	112	116	0.000020
20	24	0.001965	52	56	0.000397	84	88	0.000080	116	120	0.000016
24	28	0.001609	56	60	0.000325	88	92	0.000066			
28	32	0.001317	60	64	0.000266	92	96	0.000054			

Time Area Diagram at Pipe Number 2.001 for Storm

Total Area (ha) 0.019

Time From:	(mins) To:	Area (ha)
0	4	0.019

Time Area Diagram at Pipe Number 1.002 for Storm

Total Area (ha) 0.025

Time Area Diagram at Pipe Number 1.002 for Storm

Time (mins) From:	To:	Area (ha)
0	4	0.025

Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 5
Number of Online Controls 3 Number of Storage Structures 3 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FEH
FEH Rainfall Version	2013
Site Location	GB 540233 168902 TQ 40233 68902
Data Type	Point
Cv (Summer)	1.000
Cv (Winter)	1.000

Margin for Flood Risk Warning (mm) 300.0 DVD Status OFF
Analysis Timestep Fine Inertia Status OFF
DTS Status ON

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 180, 240, 360, 480, 600, 720, 960, 1440, 2160, 2880
Return Period(s) (years)	100
Climate Change (%)	40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
1.000	1	720 Summer	100	+40%					58.358
1.001	1	720 Summer	100	+40%					58.358
2.000	3	480 Summer	100	+40%					58.368
2.001	4	600 Summer	100	+40%					58.368
1.002	2	60 Summer	100	+40%	100/15 Summer				55.940

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	-0.012	0.000	0.00		0.0	OK	
1.001	1	-0.012	0.000	0.01		0.5	OK	
2.000	3	-0.002	0.000	0.00		0.0	OK	

Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Pipe Flow (l/s)	Status	Level Exceeded
2.001	4	-0.002	0.000	0.01		0.9	OK	
1.002	2	0.070	0.000	0.29		5.0	SURCHARGED	

1. Project & Site Details

Project / Site Name (including sub-catchment / stage / phase where appropriate)	2-4 Ringers Road and 5 Ethelbert Road
Address & post code	2-4 Ringers Road,BR1 1HT and 5 Ethelbert Road, BR1 1HU
OS Grid ref. (Easting, Northing)	E 540249
	N 168915
LPA reference (if applicable)	
Brief description of proposed work	Creation of 108 residential units in two blocks with amenity courtyard
Total site Area	1078 m^2
Total existing impervious area	925 m^2
Total proposed impervious area	426 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	Free draining or overland flow to the highways gullies/Thames Water surface
Designer Name	Claire Burroughs
Designer Position	Associate
Designer Company	Water Environment Ltd

2. Proposed Discharge Arrangements

2a. Infiltration Feasibility

Superficial geology classification	None recorded
Bedrock geology classification	Harwich Formation
Site infiltration rate	m/s
Depth to groundwater level	4.2 m below ground level
Is infiltration feasible?	Partial

2b. Drainage Hierarchy

	Feasible (Y/N)	*Proposed (Y/N)*
1 store rainwater for later use	Y	N
2 use infiltration techniques, such as porous surfaces in non-clay areas	Y	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.	Y	N

2c. Proposed Discharge Details

Proposed discharge location	Thames Water Surface Water Sewer
Has the owner/regulator of the discharge location been consulted?	TW Approved - Connection with 5l/s

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)*	*Proposed discharge rate (l/s)*
Qbar	0.02			
1 in 1	0.01	10.33		5
1 in 30	0.04	24.94		5
1 in 100	0.05	31.85		5
1 in 100 + CC				5
Climate change allowance used		40%		
3b. Principal Method of Flow Control		Flow controls with SuDS features upstream.		

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	831	531	N/A
Blue roofs	831	531	78.9
Filter strips	0	0	0
Filter drains	0	0	0
Bioretention / tree pits	0	0	0
Pervious pavements	126	126	6.3
Swales	0	0	0
Basins/ponds	0	0	0
Attenuation tanks	0		0
Total	**1788**	**1188**	**85.2**

4. Supporting Information

4a. Discharge & Drainage Strategy	*Page/section of drainage report*
Infiltration feasibility (2a) – geotechnical factual and interpretive reports, including infiltration results	Chapter 4 of Outline SuDS Report by Water Environment Ltd
Drainage hierarchy (2b)	Chapter 4 of Outline SuDS Report
Proposed discharge details (2c) – utility plans, correspondence / approval from owner/regulator of discharge location	Chapter 4 of Outline SuDS Report
Discharge rates & storage (3a) – detailed hydrologic and hydraulic calculations	Appendix of SUDs Report
Proposed SuDS measures & specifications (3b)	Chapter 4 of SuDS Report
4b. Other Supporting Details	*Page/section of drainage report*
Detailed Development Layout	Appendix of SUDs Report
Detailed drainage design drawings, including exceedance flow routes	Appendix of SUDs Report
Detailed landscaping plans	Appendix of SUDs Report
Maintenance strategy	Chapter 4 of SuDS Report
Demonstration of how the proposed SuDS measures improve:	Chapter 4 of SuDS Report
a) water quality of the runoff?	Chapter 4 of SuDS Report
b) biodiversity?	Chapter 4 of SuDS Report
c) amenity?	Chapter 4 of SuDS Report

Claire Burroughs

Water Environment Ltd
6 Coppergate Mews
Brighton Road
Surbiton
KT6 5NE

Wastewater pre-planning
Our ref DS6082180

23 March 2021

Pre-planning enquiry: Confirmation of sufficient capacity

Site: 2-4 Ringers Road, Bromley, London BR1 1JY

Dear Claire,

Thank you for providing information on your development.

Proposed site: Flats (108 units)
Proposed foul water discharge by gravity into manhole TQ40682808 for 55 units and into manhole TQ40682910 for 53 units.
Proposed surface water discharge at 5.0 l/s into surface water manhole TQ40682860 and/or TQ40682960.

We have completed the assessment of the foul water flows and surface water run-off based on the information submitted in your application with the purpose of assessing sewerage capacity within the existing Thames Water sewer network.

Foul Water

If your proposals progress in line with the details you've provided, we're pleased to confirm that there will be sufficient sewerage capacity in the adjacent foul water sewer network to serve your development.

This confirmation is valid for 12 months or for the life of any planning approval that this information is used to support, to a maximum of three years.

You'll need to keep us informed of any changes to your design – for example, an increase in the number or density of homes. Such changes could mean there is no longer sufficient capacity.

Surface Water

When developing a site, policy 5.13 of the London Plan and Policy 3.4 of the Supplementary Planning Guidance (Sustainable Design And Construction) states that every attempt should be made to use flow attenuation and SuDS/Storage to reduce the surface water discharge from the site as much as possible.

In accordance with the Building Act 2000 Clause H3.3, positive connection of surface water to a public sewer will only be consented when it can be demonstrated that the hierarchy of disposal methods have been examined and proven to be impracticable. Before we can consider your

surface water needs, you'll need written approval from the lead local flood authority that you have followed the sequential approach to the disposal of surface water and considered all practical means.

The disposal hierarchy being:

1. store rainwater for later use.
2. use infiltration techniques where possible.
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.
8. discharge rainwater to the foul sewer

Where connection to the public sewerage network is still required to manage surface water flows, we will accept these flows at a discharge rate in line with CIRIA's best practice guide on SuDS or that stated within the sites planning approval.

If the above surface water hierarchy has been followed and if the flows are restricted to a total of 5.0 l/s, then Thames Water would not have any objections to the proposal.

Please see the attached 'Planning your wastewater' leaflet for additional information.

Source Protection Zone

The development site boundary falls within a Source Protection Zone for groundwater abstraction. These zones may be at particular risk from polluting activities on or below the land surface. To prevent pollution, the Environment Agency and Thames Water (or other local water undertaker) will use a tiered, risk-based approach to regulate activities that may impact groundwater resources, this may potentially affect your drainage or surface water strategies where deep or infiltration systems are proposed. The applicant is encouraged to read the Environment Agency's approach to groundwater protection (available at *https://www.gov.uk/government/publications/groundwater-protection-position-statements* and may wish to discuss the full implications for their development with a suitably qualified environmental consultant.

What happens next?

Please make sure you submit your connection application, giving us at least 21 days' notice of the date you wish to make your new connection/s.

If you have any further questions, please contact me on 0800 009 3921.

Kind Regards,

Hemlata Gurung
Developer Services – Technical Coordinator, Sewer Adoptions Team
Tel: 0800 009 3921
hemlata.gurung@thameswater.co.uk
Get advice on making your sewer connection correctly at connectright.org.uk
Clearwater Court, Vastern Road, Reading, RG1 8DB
Find us online at developers.thameswater.co.uk