NORCUTT ROAD, TWICKENHAM

Flood Risk Assessment

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Flood Risk Assessment
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Quality Management

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EXECUTIVE SUMMARY

The site is located in Flood Zone 1 which is classified as being at low fluvial and tidal flood risk and defined as having a less than 1 in 1,000 annual probability of fluvial or tidal flooding. EA mapping shows the site to be at a 'very low' and 'low' risk of surface water flooding.

In order to meet the surface water runoff requirements underground attenuation will be provided to achieve a 1l/s discharge rate. This will help provide a reduction in surface water flood risk in the area of the site as all runoff generated on site will be controlled.

Overall, it has been demonstrated that the development would be safe from flooding, without increasing flood risk elsewhere, and that a positive reduction in flood risk would be achieved through the implementation of underground attenuation.

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1 INTRODUCTION

1.1 RPS was commissioned to undertake a Flood Risk Assessment (FRA) of *Lockcorp House, 75 Norcutt Road, Twickenham, TW2 6SR* in relation to the proposed five-storey building to provide residential accommodation.

1.2 The aim of the FRA is to outline the potential for the site to be impacted by flooding, the impacts of the proposed development on flooding in the vicinity of the site, and the proposed measures which could be incorporated into the development to mitigate the identified risk. The report has been produced in accordance with the guidance detailed in the National Planning Policy Framework (NPPF) and the associated Planning Practice Guidance (PPG). Reference has also been made to the CIRIA SuDS manual (C753), the London Borough of Richmond upon Thames (LBRuT) Strategic Flood Risk Assessment (SFRA) and the LBRuT Surface Water Management Plan (SWMP).

1.3 This report has been produced in consultation with the Environment Agency (EA) and the Lead Local Flood Authority (LLFA). The site is not located within an Internal Drainage Board (IDB) District.

1.4 This report is not intended to provide formal details of the final drainage design for the development. However, it provides information regarding the capabilities of the conceptual surface water drainage strategy to meet the requirements of the NPPF.

1.5 The desk study was undertaken by reference to information provided / published by the following bodies:

- EA;
- Centre for Ecology and Hydrology;
- British Geological Survey (BGS);
- Ordnance Survey (OS); and
- Thames Water.

2 PLANNING POLICY CONTEXT

National Planning Policy

2.1 The National Planning Policy Framework (NPPF) was released in March 2012 and was updated in February 2019. The document advises of the requirements for a site-specific Flood Risk Assessment (FRA) for any of the following cases (Planning and Flood Risk paragraph 163 (footnote 50)):

- All proposals (including minor development and change of use) located within the EA designated floodplain, recognised as either Flood Zone 2 (medium probability) or Flood Zone 3 (high probability);
- All proposals of 1 hectare (ha) or greater in an area located in Flood Zone 1 (low probability);
- All proposals within an area which has critical drainage problems (as notified to the Local Planning Authority by the EA);
- Land identified in a strategic flood risk assessment as being at increased flood risk in future; and
- Where proposed development may be subject to other sources of flooding, where its development would introduce a more vulnerable use.

2.2 Paragraph 165 of the updated NPPF identifies that major developments (developments of 10 homes or more and to major commercial development) should incorporate Sustainable Drainage Systems unless there is clear evidence that this would be inappropriate. The systems used 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 for the lifetime of the development; and

d. Where possible, provide multifunctional benefits.

2.3 Defra published their 'Non-statutory technical standards for sustainable drainage systems' in March 2015. These are supported by the revised NPPF.

Regional Planning Policy

2.4 The development site is within the London Borough of Richmond upon Thames which is covered by The London Plan, as amended March 2016. The London Plan contains various policies pertaining to flood risk and drainage, the relevant aspects of which are reproduced below.

Policy 5.12 Flood risk management

2.5 This Policy states that 'the Mayor will work with all relevant agencies including the Environment Agency to address current and future flood issues and minimise risks in a sustainable and cost effective way'.

2.6 "Development proposals must comply with the flood risk assessment and management requirements set out in the NPPF and the associated technical Guidance on flood risk over the lifetime of the development and have regard to measures proposed in Thames Estuary 2100 and Catchment Flood Management Plans".

2.7 The Policy sets out requirements for developments for which the NPPF Exception Test is applicable and developments adjacent to flood defences.

Policy 5.13 Sustainable drainage

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

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

2.9 *Drainage should be designed and implemented in ways that deliver other policy objectives of the Plan, including water use efficiency and quality, biodiversity, amenity and recreation*.'

2.10 The London Plan is supported by the Supplementary Planning Guidance: Sustainable Design and Construction, April 2014. In relation to Surface Water Flooding and Sustainable Drainage, the guidance states that developers should design Sustainable Drainage Systems (SuDS) that incorporate attenuation for surface water runoff. The minimum expectation is to achieve 50% attenuation of the undeveloped site's surface water run off at peak times. The Mayor's priority is to achieve greenfield runoff rates. Development on greenfield sites must maintain a greenfield runoff rate. Development on previously developed sites should have a runoff rate no greater than three times the calculated greenfield runoff rate.

2.11 The Consultation Draft of the Draft New London Plan was published in December 2017. The Draft New London Plan retains consideration of the above policies through the draft policies G1 Green infrastructure, G5 Urban greening, Policy SI12 Flood risk management and Policy SI13 Sustainable drainage.

Local Planning Policy

2.12 The London Borough of Richmond upon Thames Local Plan was adopted in July 2018 and contains the following Policies relating to flood risk and drainage:

Policy LP 17 - Green roofs and walls

2.13 '*Green roofs and/or brown roofs should be incorporated into new major developments with roof plate areas of 100sqm or more where technically feasible and subject to considerations of visual impact. The aim should be to use at least 70% of any potential roof plate area as a green / brown roof.*

The onus is on an applicant to provide evidence and justification if a green roof cannot be incorporated. The Council will expect a green wall to be incorporated, where appropriate, if it has been demonstrated that a green / brown roof is not feasible.

The use of green / brown roofs and green walls is encouraged and supported in smaller developments, renovations, conversions and extensions.'

Policy LP 21- Flood Risk and Sustainable Drainage

2.14 *'A. All developments should avoid, or minimise, contributing to all sources of flooding, including fluvial, tidal, surface water, groundwater and flooding from sewers, taking account of climate change and without increasing flood risk elsewhere. Development will be guided to areas of lower risk by applying the 'Sequential Test' as set out in national policy guidance, and where necessary, the*

'Exception Test' will be applied. Unacceptable developments and land uses will be refused in line with national policy and guidance, the Council's Strategic Flood Risk Assessment (SFRA) and as outlined in the table below.

In areas at risk of flooding, all proposals on sites of 10 dwellings or more or 1000sqm of non-residential development or more, or on any other proposal where safe access/egress cannot be achieved, a Flood Emergency Plan must be submitted.

Where a Flood Risk Assessment is required, on-site attenuation to alleviate fluvial and/or surface water flooding over and above the Environment Agency's floodplain compensation is required where feasible.'

[…]

Sustainable Drainage

C. The Council will require the use of Sustainable Drainage Systems (SuDS) in all development proposals. Applicants will have to demonstrate that their proposal complies with the following:

1. A reduction in surface water discharge to greenfield run-off rates wherever feasible.

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

2.15 The LBRuT SFRA identifies and maps flood risk from all sources at a borough-wide scale as well as providing guidance on producing site-specific FRAs. Relevant information from the SFRA has been referenced throughout this FRA report.

2.16 The LBRuT SWMP assesses the risk of surface water flooding within Richmond and identifies options to manage risk to acceptable level. Relevant information from the SWMP has been reproduced throughout this FRA report.

3 CONSULTATION

Environment Agency

3.1 The site is located within Flood Zone 1 and therefore the EA have not been contacted as part of the preparation of this report.

Water Authority

3.2 The public sewer network within the vicinity of the site is operated by Thames Water. A pre-development enquiry has been made to Thames Water and the outcome will be provided in Appendix A once received.

3.3 The conceptual surface water attenuation scheme presented in the FRA (see section 10) is intended to demonstrate that a feasible surface water attenuation solution can be achieved on the site to meet the requirements of the NPPF. The detailed drainage design for the proposed development will be finalised in consultation with Thames Water at detailed design stage.

Lead Local Flood Authority

3.4 The site is within the administrative boundary of LBRuT. Consultation has been undertaken with the Highway Asset Co-ordinator regarding acceptable surface water run-off rates and they have agreed that a discharge rate of 2l/s would be acceptable.

Internal Drainage Board

3.5 The site is not located within an IDB District.

4 SITE DESCRIPTION

Site Description

4.1 The site is located at National Grid Reference 515343 173383. It is irregular in shape, occupying an area of approximately 0.07 hectares (ha). The site location is presented in Figure 1.

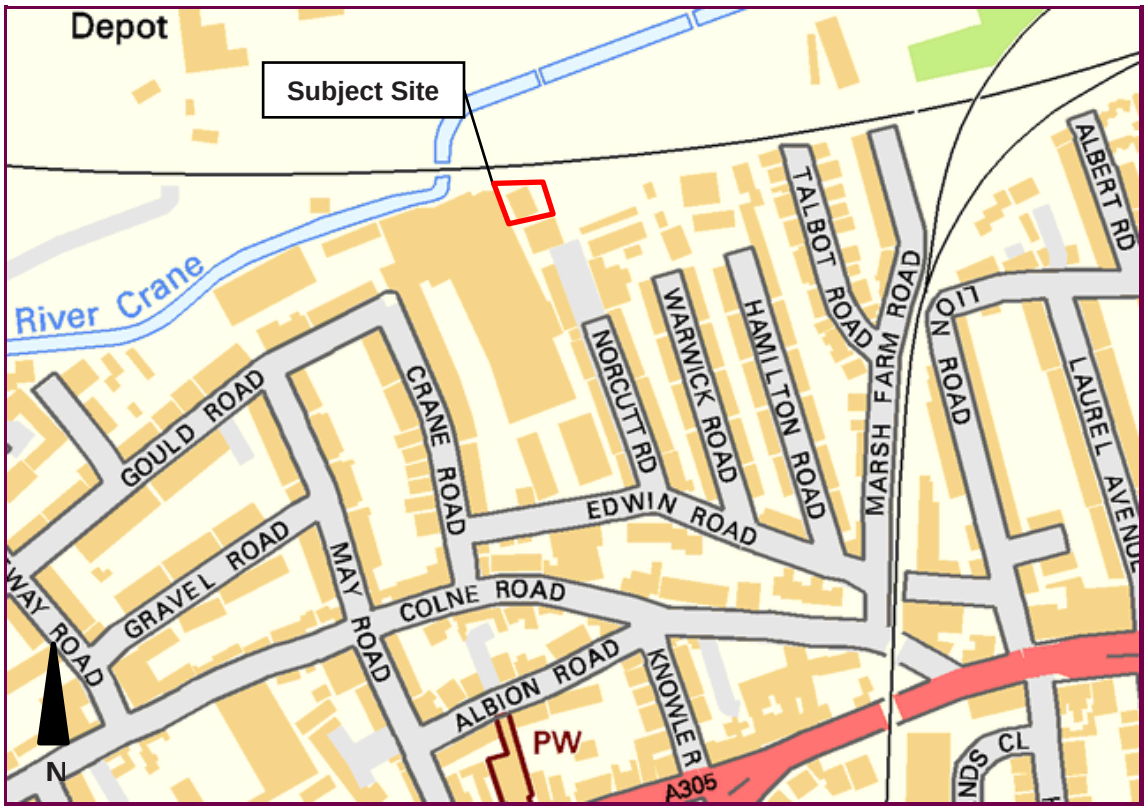

Figure 1. Site Location

4.2 The site is currently occupied by existing buildings and a small amenity area of hardstanding behind the development.

4.3 Vehicular and pedestrian access to the site is from Norcutt Road via Edwin Road.

Surrounding Land Uses

4.4 The site is located within a mixed light industrial and residential area at the end of a cul-de-sac, with the disused 'Greggs' industrial units to the west of the site and a substation to the east. A railway line is located north of the site.

4.5 The River Crane runs to the north and south-west of the site within 35m of the site boundary.

4.6 There are no designated sensitive areas (e.g. Special Area of Conservation (SAC), Special Protection Area (SPA) or Site of Special Scientific Interest (SSSI) within close proximity to the site.

Topography

4.7 A topography survey was completed by RPS in December 2018 (see Appendix B). The site is relatively flat; however, a decrease in land elevation has been identified from east to west across the site. A slight sloping has also been identified from north to south.

4.8 The highest land elevation across the site is 10.40mAOD, located in the north east of site. The lowest point of the site is 9.90mAOD seen in the north west of the site, showing a definite from sloping from east to west.

4.9 Slight sloping can also be seen from the northern boundary to the southern boundary. The northern border of the site ranges from 10.35mAOD to 10.13mAOD, whereas the southern boundary ranges from 10.19mAOD to 10.08mAOD, again showing a north to south sloping.

5 PROPOSED DEVELOPMENT

5.1 The proposed development comprises of the demolition of the existing building and the erection of a five-storey building to provide 15 residential flats. The building will be arranged over ground and four upper floor levels. A communal garden and parking area are proposed. Development plans are shown in Appendix C.

5.2 The proposed ground floor level is 10.18m AOD.

5.3 The access route for pedestrians and vehicles is located at the south of the site, accessed by Norcutt Road.

5.4 Following redevelopment, the site will be occupied approximately 60% by building footprint, 24% by hardstanding and 16% by landscaping.

5.5 The proposed use of the site is classified as 'More Vulnerable' within the PPG.

5.6 The acceptable discharge rate to the existing mains sewer will be agreed with Thames Water, following consultations with LBRuT. It is currently envisaged that discharge will continue to be to the existing surface water sewer.

5.7 The potential to provide surface water attenuation, including the use of Sustainable Drainage Systems (SuDS), has been considered as part of the preliminary design process (see Section 10 – Surface Water Management).

6 HYDROLOGICAL SETTING

Nearby Watercourses

6.1 Reference to OS Mapping indicates that the nearest surface water feature is the River Crane which is located approximately 35m northwest of the site. The River Thames, the closest Main River, flows at approximately 950m to the south east of the site.

6.2 OS Mapping identifies 3 weirs along the River Crane, located within 200m north, north east and west of the site.

6.3 No significant artificial watercourses or significant features (e.g. canals, reservoirs) have been identified within 1km of the site.

Fluvial / Tidal Flood Risk Classification

6.4 EA Flood Map for Planning, which is available online, indicates that the site is located within Flood Zone 1, classified as being at low risk and defined as having a less than 1 in 1,000 annual probability of fluvial and tidal flooding. The EA Flood Map for Planning is provided in Figure 2.

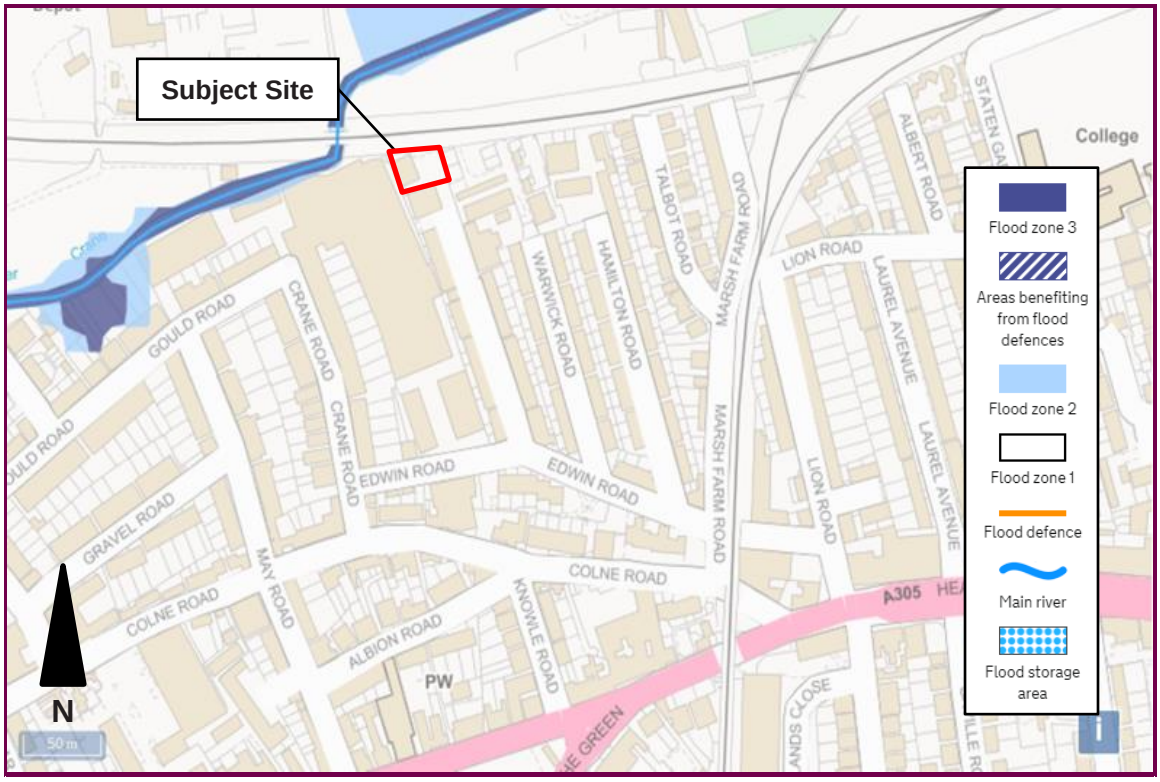

Figure 2. EA Flood Map for Planning

Surface Water Flood Risk Classification

6.5 The EA's Flood Map for Surface Water, which is available online, indicates that site is at 'very low' risk of surface water flooding defined as having less than 1 in 1000 annual probability of flooding from surface water. However, it is possible that flooding may encroach the western boundary of the site, as the area located to the west is at 'low' risk of flooding from surface water defined as having an annual probability of surface water flooding of between 1 in 1000 and 1 in 100. The updated Flood Map for Surface Water is presented in Figure 3.

Figure 3. Updated Flood Map for Surface Water

Reservoir Flood Risk Classification

6.6 EA mapping also indicates that the site is not located within an area potentially at risk from reservoir flooding.

Local Authority Documents

6.7 The LBRuT SFRA was published in March 2016. It provides an overview of flood risk from various sources within the borough. Information relevant to this assessment is summarised below:

- The SFRA identifies no significant fluvial or tidal flood risks to the site;
- Thames Water and LBRuT have not identified any records of sewer flooding for the site;
- The council have assessed the risk of groundwater flooding across the LBRuT as low, due to the overlay of London Clay Formation, which has been identified across the site;
- The LBRuT have not identified any records of surface water flooding for the site;
- The LBRuT have not identified any records of multiple source flooding for the site;
- Evidence of historic groundwater flooding within the LBRuT is relatively limited and no records of groundwater flooding have been identified within the site boundary;
- The EA provide a free flood warning service for many areas at risk of flooding from rivers and the sea. The Site is not located in a Flood Warning Area.

6.8 The LBRuT SWMP was published in September 2011. It provides an overview of flood risk from surface water within the borough. Information of relevance to this assessment is summarised below:

- The SWMP provides a record of groundwater flooding, the record shows 1 incident of a flooded cellar within Richmond in 2003, however, the incident occurred over 4km away from the site.
- Figure 4.31 in the SWMP identifies that that site is located on land classified an area where ‘Infiltration SUDS Suitability Uncertain -Site investigation required’;
- Figure 3.8.3a in the SWMP identifies that the site is not located in a Critical Drainage Area (CDA);

- Figure 3.8.3b identifies that an isolated area of the site is at a flood hazard risk of '0.75-1.25 Moderate (Danger for some)' for surface water for a 1 in 100 chance of rainfall event occurring in any given year (1% AEP);
- The SWMP assessed the general risk of groundwater flooding within the borough as low, however areas located adjacent to watercourses are an increased risk where basements and cellars are present.

7 HYDROGEOLOGICAL SETTING

7.1 British Geological Survey (BGS) online mapping (1:50,000 scale) indicates that the site is situated on superficial deposits of the Kempton Park Gravel Member, made up of sand and gravel. This is underlain by London Clay formation, comprising of clay and silt.

7.2 BGS online mapping does not have any freely available borehole records in the area of the site.

7.3 A previous Phase 1 & Phase 2 Site Investigation undertaken at the site by Risk Management Limited in February 2014 (reference RML 5294) did not encounter groundwater in the boreholes that were excavated to 4m below ground level (bgl).

7.4 The soils are described as ‘freely draining slightly acid loamy soils’ by the National Soils Research Institute.

7.5 According to the EA’s Aquifer Designation Mapping, the bedrock is classified as an Unproductive Aquifer, defined by the EA as “rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow”. However, the superficial aquifer is classified as a Principal Aquifer. This is described by the EA as “layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage”.

7.6 EA online groundwater Source Protection Zone (SPZ) mapping indicates that the site is not located within a groundwater SPZ.

8 EXISTING DRAINAGE / WATER MAINS

8.1 Thames Water plans of public sewers, included as Appendix D, indicates that the site is served by Trunk foul sewer, an additional foul sewer and a surface water sewer, which are located within the site boundary. The trunk foul sewer has a diameter of 914mm and flows westerly across the site and under the existing building. The surface water and foul sewers are of 225mm diameter and flow northerly through the south east of the site and both appear to merge with the trunk foul water sewer.

8.2 The site has three manholes present within the Site boundary, references 3303 (surface water), 3301B (trunk foul) and 3307 (foul).

Table 1. Manhole level details

Manhole Reference	Manhole Cover Level (mAOD)	Manhole Invert Level (mAOD)	Invert Depth (m)
3303	10.06	7.01	3.05
3301B	10.04	0.29	9.75
3307	10.08	6.96	3.12

8.3 The site is also served by a 100mm diameter water main which flows up Norcutt Road to within the southeast of the site boundary.

9 FLOOD RISK AND MITIGATION

9.1 The key sources of flooding that could potentially impact the site are discussed below:

Fluvial / Tidal Flooding

9.2 The EA Flood Map for Planning, as seen in Figure 2, indicates that the Site is located within Flood Zone 1. The annual probability of fluvial and tidal flooding is classified as having less than 1 in 1,000 annual probability of flooding.

9.3 The EA historical flood map indicates that the site has not been subject to historical flooding.

9.4 The access route for pedestrians and vehicles is located at the south of the site from Norcutt Road which is also within Flood Zone 1.

9.5 Due to the site being located in Flood Zone 1, there will be no loss of flood storage and no increase in flooding on site or in surrounding areas.

9.6 The PPG details the suitability of different land uses within each flood zone. The proposed land use is classified as a 'More Vulnerable' development and such uses are generally considered appropriate within Flood Zone 1.

9.7 Overall the fluvial flood risk is considered to be low.

Proposed Mitigation

9.8 No mitigation is considered to be necessary.

Flooding from Sewers

9.9 Sewer flooding can occur during periods of heavy rainfall when a sewer becomes blocked or is of inadequate capacity. The site is currently served by Thames Water (detailed in Section 8). Thames Water advised that they don't have any recoded incidents of flooding in the requested area as a result of surcharging public sewers.

9.10 The discharge rate to the existing sewer will be agreed with Thames Water to ensure that there is capacity to receive discharge from the site without significantly increasing flood risk.

Proposed Mitigation

9.11 No mitigation is considered to be necessary.

Surface Water Flooding (Overland Flow)

9.12 This can occur during intense rainfall events, when water cannot soak into the ground or enter drainage systems.

9.13 The EA flood map for surface water indicates that the site does not appear to be at risk surface water flooding. There is a low risk of surface water flooding along the western boundary of the site, however it appears that the surface water runoff follows the preferential route of the road and the risk of the flow to encroach into the site boundary is low.

9.14 Surface water flooding from on-site sources is considered in Section 10 of this report.

9.15 At present it is assumed that all surface water currently drains into the Thames Water sewer system. The proposed development must aim to reduce the discharge of surface water into the water system.

Proposed Mitigation

9.16 Where feasible, it is recommended that finished ground floor levels are elevated 150mm above external site levels, to afford the building a degree of protection against overland flow.

Groundwater Flooding

9.17 This can occur in low-lying areas when groundwater levels rise above surface levels, or within underground structures. BGS mapping indicates that the site is underlain by the Kempton Park Gravel Formation which has the potential to contain elevated groundwater, although the previous Site Investigation undertaken in 2014 indicates a groundwater resting depth of at least 4m bgl.

9.18 No records of groundwater flooding have been identified within the site boundary in the SFRA.

9.19 The SWMP considered the risk of groundwater flooding on superficial aquifers including river terrace deposits to be limited to basements and cellars.

9.20 No basement levels are proposed at the site.

Proposed Mitigation

9.21 On the basis that no basement levels are proposed, no mitigation is considered necessary.

Other Sources

9.22 There is a limited risk of flooding occurring as a result of a break in a water main. The locations of the water mains in the immediate vicinity of the site are described in Section 8. Should a water main burst water would likely flow in a westerly direction, following site topography, and is therefore unlikely to pond in the vicinity of the building.

9.23 The risk of flooding associated with reservoirs, canals and other significant artificial structures is considered to be low given the absence of any such structures in the site vicinity. In addition, the EA reservoir mapping shows that the site is not at risk of flooding from reservoirs

Proposed Mitigation

9.24 No mitigation is considered to be necessary.

Event Exceedance and Residual Risk

9.25 The mitigation measures proposed as part of the development scheme are considered appropriate to mitigate against any residual risks or event exceedance scenarios.

10 SURFACE WATER MANAGEMENT

Introduction

10.1 The proposed development comprises a five-storey residential development. As a result of the proposed development, the permeable area at the site will increase. For the purposes of surface water management, a conservative approach has been taken calculating attenuation storage for the site as 100% impermeable.

10.2 Generally, this type of development is considered to have a design life of 100 years. Therefore, for the purposes of this assessment, taking into account the Environment Agency's climate change allowances (published in February 2016), a 40% increase in peak rainfall intensity has been included as climate change allowance, which caters up to the year 2115. No climate change guidance is available beyond 2115.

10.3 The SFRA states "details of proposed sustainable drainage systems (SuDS) that will be implemented to ensure that runoff from the site (post redevelopment) does not exceed greenfield runoff".

Greenfield and Existing Surface Water Runoff Rates

10.4 The greenfield run-off rates for the proposed impermeable area have been calculated using the Interim Code of Practice for Sustainable Drainage Systems (ICP SuDS) Method. The existing greenfield rates are presented in Table 2 below. ICP SuDS calculations are included as Appendix E.

Table 2. Existing surface water runoff rates

Return Period	Greenfield Runoff Rate (l/s)
1 in 1	0.1
Q_{BAR}	0.1
1 in 30	0.2
1 in 100	0.3

Q_{BAR} = mean annual flood flow

10.5 The site comprises an old commercial unit. The existing brownfield runoff rate has been estimated using the Rational Method:

Q (standardised flow) x Proposed impermeable area (ha) x Average rainfall* (mm)

**London Heathrow station data, Met Office, 2018 (1981 – 2018)*

2.78 x 0.07 x 50.50 = 9.83l/s

Proposed Run-off Rates

10.6 On the basis that the greenfield runoff rate is lower than the minimum discharge rate feasible, it is proposed to restrict surface water run-off to 1.0l/s. In order to achieve this restriction, an attenuation feature of volume 37.9m^3 would be provided for all events up to and including the 1 in 100 year plus 40% climate change event. This calculation takes into account a 95% void ratio in the attenuation feature.

10.7 Restricting runoff rates to 1.0l/s corresponds to an 89% betterment in the above existing discharge rate, and therefore satisfies regional policy when greenfield rates are below the feasible minimum to allow for a self-cleansing system.

Consideration of Drainage Hierarchy

10.8 The PPG advises of the following hierarchy for the disposal of surface water;

1. Infiltration;
2. To a surface water body;
3. To a surface water sewer, highway drain or another drainage system; or
4. To a combined sewer.

10.9 The drainage hierarchy has been considered as follows.

Infiltration

10.10 The use of infiltration techniques is not suitable within 5m of a building or 5m of Network Rail land and therefore infiltration is not suitable for inclusion at this site.

To a Surface Water Body

10.11 There are no surface watercourses within or adjacent to the development site therefore it is not feasible to discharge to a surface water body.

To a Surface Water Sewer, Highway Drain or Another Drainage System

10.12 It is proposed to discharge to the existing Thames Water surface water sewer beneath the site. It is acknowledged that this sewer appears to flow into the trunk foul sewer. Discharge consent will be obtained from Thames Water and a pre-development enquiry has been submitted.

To a Combined Sewer

10.13 It is proposed to connect to an existing surface water sewer.

Consideration of Sustainable Drainage Systems

10.14 The potential for the use of Sustainable Drainage Systems (SuDS) to provide attenuation within the development has been considered as follows:

Infiltration SuDS Features

10.15 Reference to BGS mapping indicates the Site is underlain by London Clay Formation (bedrock) and the Kempton Park Gravel Formation (superficial deposits). Whilst the reported geology beneath the Site indicates that soakaways or other infiltration-based SuDS techniques could provide a feasible method for the disposal of surface water run-off, there are insufficient external areas greater than 5m from the building, site boundary and Network Rail land in which to use infiltration techniques.

Rainwater Harvesting

10.16 The attenuation benefits provided through the use of rainwater harvesting are considered to be limited and would only be realised when the tanks were not full. Rainwater harvesting has therefore not been proposed at the site at this stage. Given the provision of a communal garden, smaller scale rainwater harvesting measures such as water butts could be considered at the site.

Green Roofs

10.17 It is not proposed to include green roofs in the proposed development.

Permeable / Porous Paving

10.18 It is not proposed to use permeable paving at the site. The use of infiltration techniques is not suitable and there are very limited areas in which a lined permeable paving system could be incorporated.

Swales, Detention Basins and Ponds

10.19 Landscaped open storage features like swales and detention basins have not been proposed due to limited external space at the site.

Modular Underground Attenuation Tanks

10.20 Given the constraints mentioned above, it is proposed to use geo-cellular underground attenuation crates.

Conceptual Surface Water Drainage Strategy

10.21 A minimum of 33m^2 of underground attenuation crates are proposed with a depth of 1.2m providing a minimum crate volume of 37.9m^3. Accounting for the 95% void within the crate system this provides the required attenuation volume of 37.6 m^3. The MicroDrainage calculations to support this are provided in Appendix E. Surface water runoff is then conveyed from the crates to a flow control chamber where the discharge is restricted to 1l/s. This is then conveyed easterly to the Thames Water surface water sewer. The surface water management scheme is presented in the Conceptual Surface Water Drainage Layout, included as Appendix F.

10.22 Following the Drainage Hierarchy, the potential for storage and infiltration of runoff has been considered. Storage within open features is not feasible given the limited size of the site and infiltration methods are not appropriate given the proximity to the building and Network Rail land. However, storage will be provided within the underground attenuation crates for gradual release. This will ensure that runoff is managed as close to the source as possible. Given the absence of any adjacent surface watercourses, runoff will be discharged to the surface water sewer which is also in accordance with the Hierarchy. The necessary consents will be obtained from Thames Water with whom the final discharge rate would be agreed.

10.23 Overall, the proposed development will meet local, regional and national planning policy requirements through incorporating attenuation to achieve a discharge rate of 1 l/s. As a result of the proposed measures, there will be a reduction in runoff rates and therefore surface water flood risk within the local area.

Maintenance of Sustainable Drainage Systems

10.24 As described in the CIRIA SuDS Manual C753, regular inspection and maintenance will be required following construction to allow effective operation of the proposed surface water drainage network and SuDS features. A SuDS Maintenance Plan for the proposed SuDS features is included as Appendix G. A detailed maintenance programme will be required as part of the detailed drainage design for the Site.

SuDS Proforma

10.25 Summary details of the drainage strategy are provided in the LLFA's drainage assessment form, included as Appendix H.

Event Exceedance

10.26 The proposed indicative surface water drainage concept provides underground storage up to the 1 in 100 year plus climate change event. In an event exceeding this magnitude, a flow exceedance plan has been provided in Appendix I to indicate where surface water may flow.

10.27 Detailed drainage design will identify mitigation measures to ensure that the resulting above-ground flooding will be confined to temporary shallow flooding of the on-site road network and will not affect the buildings on site or significantly increase flood risk to off-site locations.

10.28 Event exceedance planning will be undertaken as part of the final design process. Suitable mitigation measures will be incorporated into the development to ensure water is retained on-site should surcharging of on-site drains occur during extreme rainfall events.

Further Benefits of SuDS Measures

Water Quality

10.29 The proposed underground attenuation storage crates will be wrapped in a geotextile impermeable membrane. This will ensure that the typical pollutants present in residential runoff, for example hydrocarbons and chlorides, will not infiltrate into the soil and will be washed into the sewer system to be treated at the local wastewater treatment works.

Environmental Benefits

10.30 The SuDS measures have benefits in effective flood risk reduction. Underground attenuation storages crates have high void ratios providing high storage volume capacity that is capable of managing high flow events. High flows can be destructive to the environment as soft landscaping, such as the private gardens and communal play area at the site, is prone to waterlogging which can destroy habitats and be detrimental to soil health.

Social Benefits

10.31 By their nature, underground attenuation storage crates are lightweight and flexible, and have good long-term physical and chemical stability, requiring very low maintenance. These characteristics help SuDS measures to be the most cost-effective solution in both capital and operational terms, which has benefits in social provision by not disproportionately raising the price of the new residential units. In addition such features will help to maintain the required flow rate from the site for rainfall events up to the 1 in 100 year plus 40% climate change event and as such assist in reducing the potential for surface water flooding within the catchment.

11 SEQUENTIAL TEST AND EXCEPTION TEST

Sequential Test

11.1 The NPPF requires the Local Authority to apply the Sequential Test in consideration of new development. The aim of the Test is to steer new development to areas at the lowest probability of flooding.

11.2 The PPG details the suitability of different land uses within each flood zone. The proposed land use is classified as a 'More Vulnerable' development and such uses are generally considered appropriate within Flood Zone 1. No significant risks of flooding have been identified at the site and as such it is considered to pass the Sequential Test.

The Exception Test

11.3 According to Table 3 of the PPG to the NPPF, 'More vulnerable' developments are considered appropriate within Flood Zone 1 without the requirement to apply the Exception Test. Therefore, application of the Exception Test is not required for the proposed development.

12 SUMMARY AND CONCLUSIONS

12.1 The aim of the FRA is to outline the potential for the site to be impacted by flooding, the potential impacts of the development on flooding both onsite and in the vicinity, and the proposed measures which can be incorporated into the development to mitigate the identified risks. The report has been produced in accordance with the guidance detailed in the NPPF. Reference has also been made to the CIRIA SuDS manual (C753), the SFRA and the SWMP and following consultation with the LLFA.

12.2 The potential flood risks to the site, and the measures proposed to mitigate the identified risks, are summarised in Table 3.

Table 3. Proposed mitigation

Source of Flooding	Identified Risk			Mitigation Proposed	Residual Risk		
	L	M	H		L	M	H
Fluvial	✓			No mitigation considered necessary	✓		
Tidal	✓				✓		
Sewers	✓				✓		
Surface Water	✓			Finished ground floor levels to be elevated 150mm, where feasible	✓		
Groundwater	✓			No mitigation considered necessary	✓		
Other Sources (e.g. reservoirs, water mains)	✓			No mitigation considered necessary	✓		

12.3 The site is located within Flood Zone 1, classified as being at low risk and defined as having a less than 1 in 1,000 annual probability of fluvial and tidal flooding. The site has been identified to be in an area of 'very low' surface water flood risk.

12.4 In order to meet the surface water runoff requirements of the NPPF, Non-statutory technical standards for SuDS and the London Plan, underground attenuation will be provided to achieve a 1l/s discharge rate.

12.5 It has been demonstrated that the development meets the Sequential and Exception Tests imposed under the NPPF.

12.6 Overall, it has been demonstrated that the development would be safe from flooding, without increasing flood risk elsewhere, and that a positive reduction in flood risk would be achieved through the implementation of underground attenuation.

APPENDICES

Appendix A

Thames Water Pre-Development Enquiry Response *(to be included in final report)*

Appendix B

Topographic Survey

Notes

1. This drawing has been prepared in accordance with the scope of RPS's appointment with its client and is subject to the terms and conditions of that appointment. RPS accepts no liability for any use of this document other than by its client and only for the purposes for which it was prepared and provided.
2. If received electronically it is the recipients responsibility to print to correct scale. Only written dimensions should be used.
3. This drawing should be read in conjunction with all other relevant drawings and specifications.

GENERAL NOTES :-

THIS TOPOGRAPHICAL SURVEY HAS BEEN PROVIDED BY A THIRD PARTY.

THIS DRAWING HAS BEEN PRODUCED WITH A PLOT SCALE ACCURACY OF 1:100

SERVICE COVERS INDICATED WHERE VISIBLE. PIPE INVERTS / DETAILS SURVEYED FROM SURFACE INSPECTION ONLY. GENERALLY DAMAGED COVERS AND COVERS WITHIN HIGHWAYS WILL NOT BE LIFTED

TREE SPECIES SHOULD BE CONFIRMED BY TREE SPECIALIST IF CRITICAL.

OVERHEAD CABLES ARE INDICATED USING REMOTE SURVEY METHODS AND ARE SUBJECT TO SEASONAL VARIATION, AND SHOULD BE TREATED AS APPROXIMATE.

SERVICE COVERS LOCATED UNDER PARKED VEHICLES/MOBILE STRUCTURES MAYBE OMITTED.

BURIED SERVICE COVERS WILL NOT BE INDICATED.

TOPOGRAPHICAL SURVEY/UTILITY KEY :-

(ht) – height
ø – diameter
● – pvc trap
o/g – above ground
o/r – assumed route
av – air valve
bb – bellaha beacon
bd – back drop
boll – bollard
bos – bottom of shaft
bt – telecom
c/b fence – closeboard fence
c/box – control box
catv – cable television
cl – cover level
con – conifer
cr – cable riser
cwc – combined water sewer
d/chan – drainage channel
dp – depth
ejb – electric junction box
elec – electric
eot – end of trace
ep – electric pole
er – earth rod
f/bed – flower bed
fh – fire hydrant
fl – floor level
fs – fire switch
fwc – foul water chamber
fws – foul water sewer
g – gully
g/run – gully run
gr – gas riser
h/chestnut – horse chestnut
h/thorn – hawthorn
ic – inspection cover
il – invert level
ill – illuminated
int – interceptor
lp – lamp post
mh – manhole cover
mkr – marker
o/h – over head
ot – off let
oss – off survey area
OSBM – ordnance survey bench mark
p & r fence – post & rail fence
pd – pit depth
ptg – pipe to ground
rs – rodding eye
ret wall – retaining wall
rs – road sign
rwp – rain water pipe
s/birch – silver birch
s/p – safety paving
sap – sapling
sec fence – security fence
sfc – soil filled chamber
sl – spot light
sp – soil pipe
st – stop tap
sv – stop valve
svp – soil vent pipe
sws – storm water sewer
TBM – temporary bench mark
tfr – taken from records
tl – threshold level
toc – top of cap
top – top of pipe
tot – top of tank
tp – telecom pole
ts – traffic signal
t/s – to surface
u/s – underside
util – unable to lift
utr – unable to rod
uts – unable to survey
utt – unable to trace
vp – vent pipe
wfc – water filled chamber
wl – water level
wm – water meter
wp – waste pipe
wr – water riser

UTILITY SURVEY KEY :-

HATCHED AREA
BOREHOLE
CPT
TRIAL PIT
HAND PIT
WINDOW SAMPLE

ELECTRIC CABLE
WATER PIPE
FOUL SEWER
STORM SEWER
COMBINED SEWER
DUCTS
CABLE TELEVISION
DATA CABLE
TELECOM CABLE
GAS PIPE
UNIDENTIFIED SERVICE
OTHER
CCTV
TRAFFIC LIGHT
OFFSET FILL
VENT
FUEL PIPE
GAUGE LINES
PIPE
ASSUMED ROUTE
TAKEN FROM RECORDS

DISCLAIMER :-

Electromagnetic techniques have been used in the location of underground services. The results are not infallible and trial excavations should be carried out to confirm service identification, positions and particularly depths, where these are critical. The completeness of the underground services information cannot be guaranteed.

This method of survey does not differentiate between live and dead services, and as such all services should be treated as live. This drawing may not include the location of all public services that may cross the site, therefore the relevant service drawings should be obtained from the appropriate utility company and used in conjunction with this drawing.

Private service pipes and cables in highways are not shown, but there presence should be anticipated.

Additional below ground structures or obstructions not shown on this drawing may be present. Reference should be made to historical plans and as–built drawings. Excavations in the vicinity of services should be carried out with due diligence ref: HSG47 document avoiding dangers from underground services

Please note that factors such as ground conditions, proximity of other utilities, material and method of construction have an influence on the quality of the data collected on site.

TSA Standards – "Even an appropriate and professionally executed survey may not be able to achieve a 100% detection rate."

UTILITY NOTES :-

–INCOMING CABLE TV TO THE SITE IS AN EMPTY DUCT, STOPPING JUST AFTER THE GATE.
–ALL DRAINS HAVE BEEN RODDED AND MAPPED.
–A FOUL WATER MAIN WAS FOUND. THIS WILL REQUIRE MANHOLE ENTRY TO BE ABLE TO SURVEY.
–NO RECORDS HAVE BEEN PROVIDED.
–THE INCOMING BT COULD NOT BE TRACED INTO SITE FROM SOURCE.
–NO ACCESS TO BUILDING AT TIME OF SURVEY. UNABLE TO SHOW INCOMING RISERS/POSSIBLE INTERNAL RWP'S.
–WE WOULD RECOMEND THAT A SERVICE RECORD SEARCH IS CONDUCTED. THIS WILL SHOW ROUTE OF MAIN SEWER THROUGH SITE.
–I WOULD RECOMEND THAT A CCTV DRAINAGE SURVEY IS CONDUCTED TO CONFIRM DRAINAGE TO END OF TRACES.

Rev	Description	By	Ckd	Date
B	UTILITIES & DRAINAGE INFORMATION ADDED	MSL	AHP	21.12.18
A	ORIGINAL DRAWING ISSUE	KK	AHP	12.12.18

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Client LEEK REAL ESTATE

Project 75 NORCUTT ROAD,
TWICKENHAM,
TW2 6SR

Title TOPOGRAPHICAL SURVEY

Status	Scale	Date Created
FINAL	1:100 @A1	12.12.18
Project Leader	Drawn By	Checked by
AH	KK	AHP

Document Number	Revision	Suitability
JKK10321– 01	B	-
Project Number / Originator - Zone - Level - Type - Role - Drawing Number		

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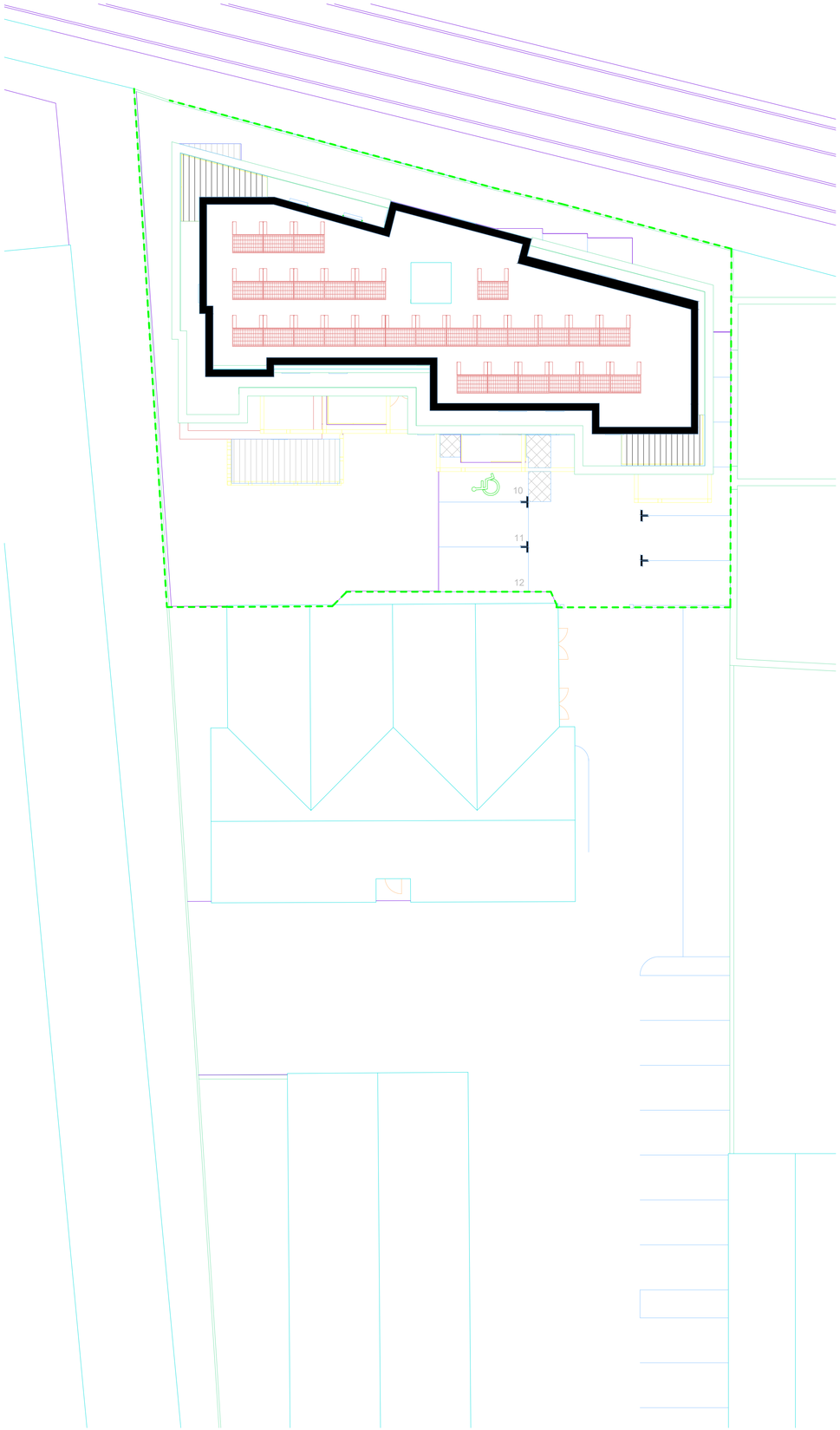
Appendix C

Development Plans



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All other design team elements, where indicated, have been imported from the consultant's drawings and reference should be made to the individual consultant's drawings for exact setting out, size and type of component.

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Safety, Health & Environmental Information
Refer to the relevant Construction (Design and Management) documentation where applicable.

It is assumed that all works on this drawing will be carried out by a competent contractor, working where appropriate to an approved method statement.

Schedule of Accommodation (NSA) - Option 1

Name	Comments	Area m²	Area ft²
Flat 1	3B 5P (M4(3))	102	1100
Flat 2	2B 3P	62	680
Flat 3	1B 2P	53	570
Flat 4	1B 2P	52	560
Flat 5	2B 3P	64	690
Flat 6	2B 3P	62	680
Flat 7	1B 2P	53	570
Flat 8	1B 2P	52	560
Flat 9	2B 3P	64	690
Flat 10	2B 3P	62	680
Flat 11	1B 2P	53	570
Flat 12	1B 2P	52	560
Flat 13	2B 3P	64	690
Flat 14	3B 4P	89	935
Flat 15	3B 4P	86	925
Total		971	10460

Schedules of Areas (GIA) - Option 1

	Area m²	Area ft²
Ground Floor	174	1875
First Floor	287	3090
Second Floor	287	3090
Third Floor	287	3090
Fourth Floor	205	2205
Total	1239	13350

GIA includes rear gallery access.

All areas are approximate

0 1 2 3 4 5 10 m

PLANNING

Rev	Description	Issued	Dwn	Chk
A	Preliminary Planning Issue	03/05/19	CK	CH

Client
Leek Real Estate (No. 1) Ltd

Project
Lockcorp House, 75 Norcutt Road
Twickenham, TW2 6SR

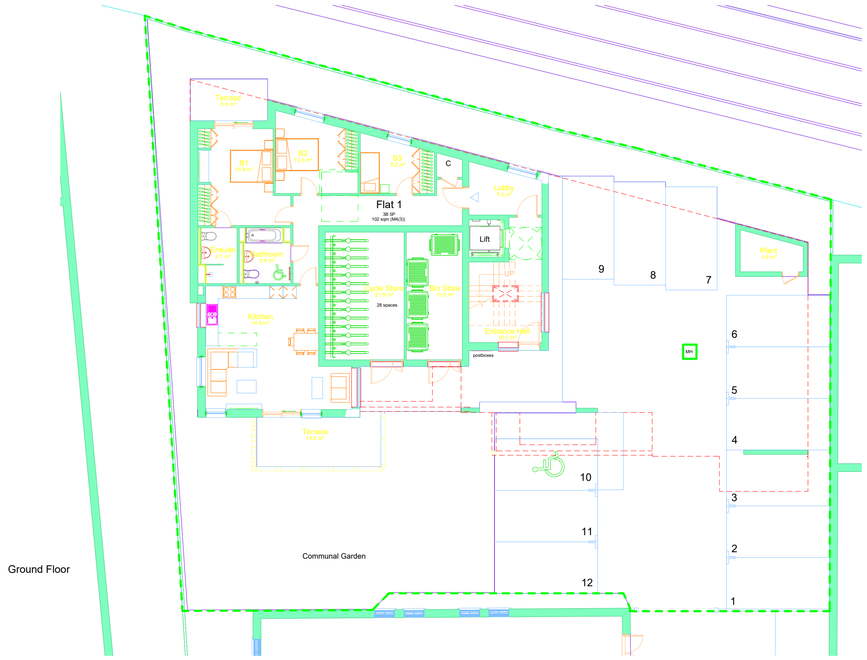
Drawing
PROPOSED
Site Plan / Roof Plan

Scale	Date	Drawn	Checked
1 : 100@A1	Dec 18	CK	CH

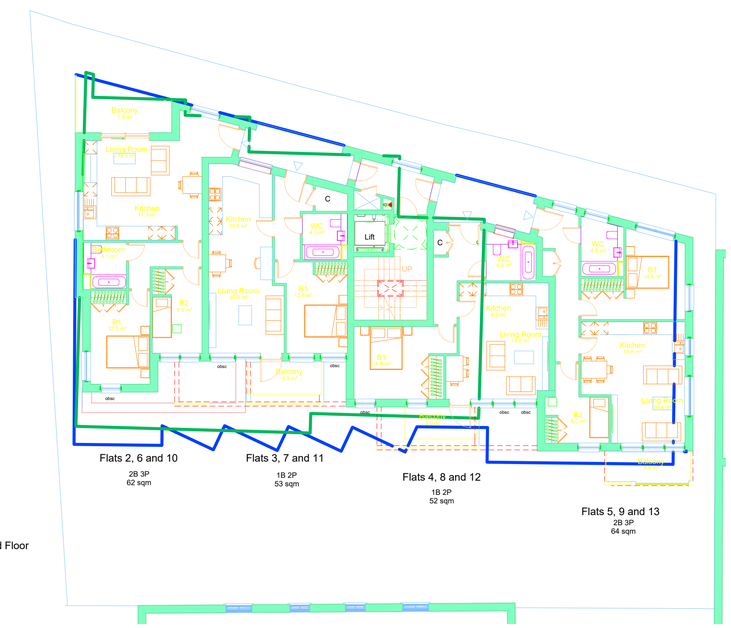
1 **Option 1 - 00- Site**
1 : 100

5076 | 3 | 01 | Rev. No. A

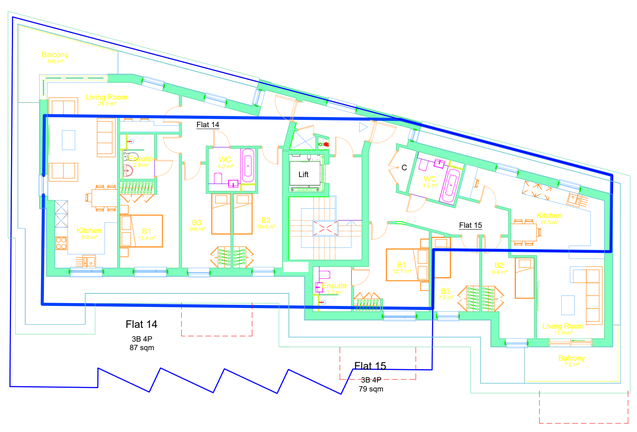
Ground Floor



First, Second and Third Floor



Fourth Floor



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Student Scheme Overlay

Flat Scheme Overlay

0 1 2 3 4 5 10 m

PLANNING

Rev.	Description	Issued	Dwn	Chk

Client
Leek Real Estate (No. 1) Ltd

Project
Lockcorp House, 75 Norcutt Road
Twickenham, TW2 6SR

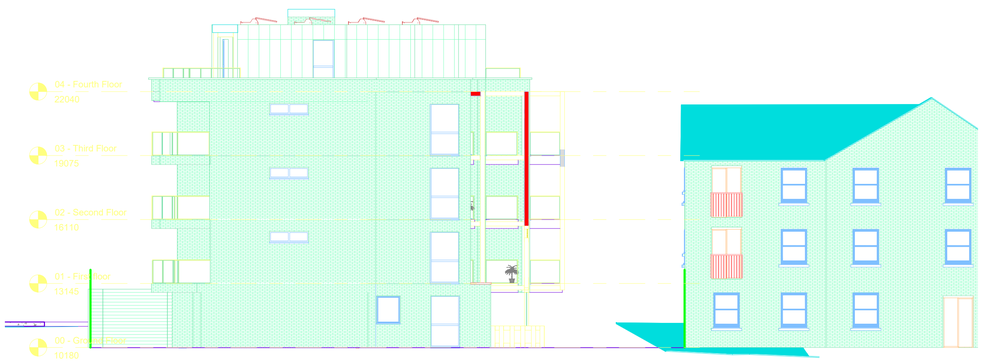
Drawing
PROPOSED
General Arrangement Floor Plans

Scale	Date	Drawn	Checked
1:100@A1	12/18/18	CK	CH

			Rev. No.
5076	3	02	A

1 South Elevation
1 : 100

2 North Elevation
1 : 100



3 West Elevation
1 : 100

4 East Elevation
1 : 100

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0 1 2 3 4 5 10 m

PLANNING

Rev	Description	Issued	Dwn	Chk

Client
Leek Real Estate (No. 1) Ltd

Project
Lockcorp House, 75 Norcutt Road
Twickenham, TW2 6SR

Drawing
PROPOSED
General Arrangement Elevations

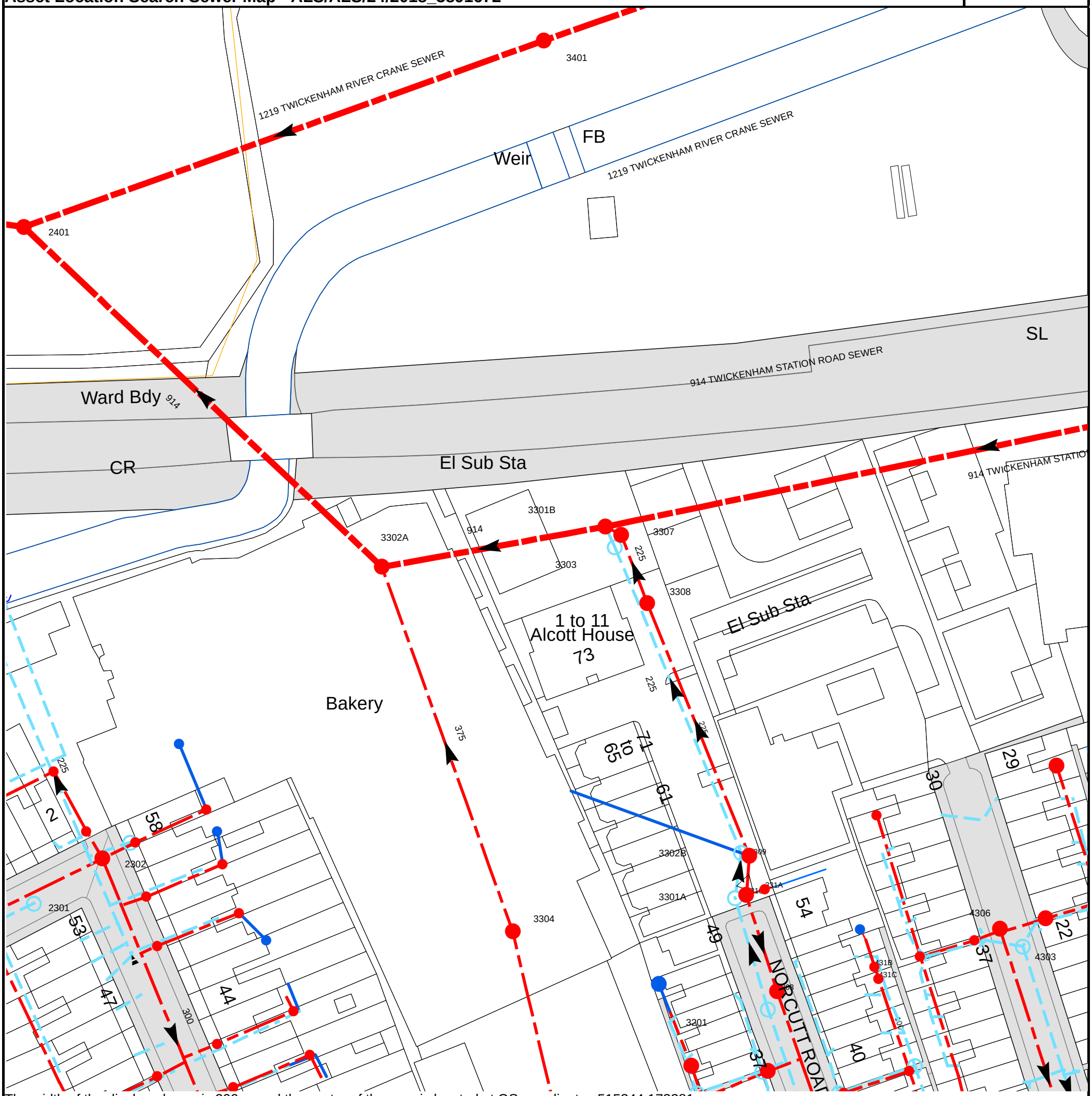
Scale	Date	Drawn	Checked
1 : 100@A1	12/18/18	CK	CH

			Rev. No.
5076	3	03	B

Appendix D

Thames Water Sewer Plans

Asset Location Search Sewer Map - ALS/ALS/24/2018_3891672



The width of the displayed area is 200 m and the centre of the map is located at OS coordinates 515344,173381

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
43SV	n/a	n/a
4306	n/a	n/a
4303	n/a	n/a
43TY	n/a	n/a
43TW	n/a	n/a
43WT	n/a	n/a
43TS	n/a	n/a
32YT	n/a	n/a
32QW	n/a	n/a
3301A	n/a	n/a
3302B	n/a	n/a
3310	n/a	n/a
3309	n/a	n/a
32QV	n/a	n/a
331A	n/a	n/a
32RS	n/a	n/a
3201	n/a	n/a
3203	n/a	n/a
32RZ	n/a	n/a
32SQ	n/a	n/a
43WY	n/a	n/a
431B	n/a	n/a
43SS	n/a	n/a
431C	n/a	n/a
42IR	n/a	n/a
42OZ	n/a	n/a
43SW	n/a	n/a
43SP	n/a	n/a
22BB	n/a	n/a
22QR	n/a	n/a
32YX	n/a	n/a
22AX	n/a	n/a
22AW	n/a	n/a
33ZT	n/a	n/a
23ZR	n/a	n/a
23ZT	n/a	n/a
3304	n/a	n/a
23ZS	n/a	n/a
2301	n/a	n/a
23ZW	n/a	n/a
23ZX	n/a	n/a
2302	n/a	n/a
23VP	n/a	n/a
23VV	n/a	n/a
23ZY	n/a	n/a
23WW	n/a	n/a
23VQ	n/a	n/a
23WX	n/a	n/a
23VS	n/a	n/a
3308	n/a	n/a
3302A	10.03	.2
3303	10.06	7.01
3307	10.08	6.96
3301B	10.04	.29
2401	10.89	.03
3401	8.98	.12

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

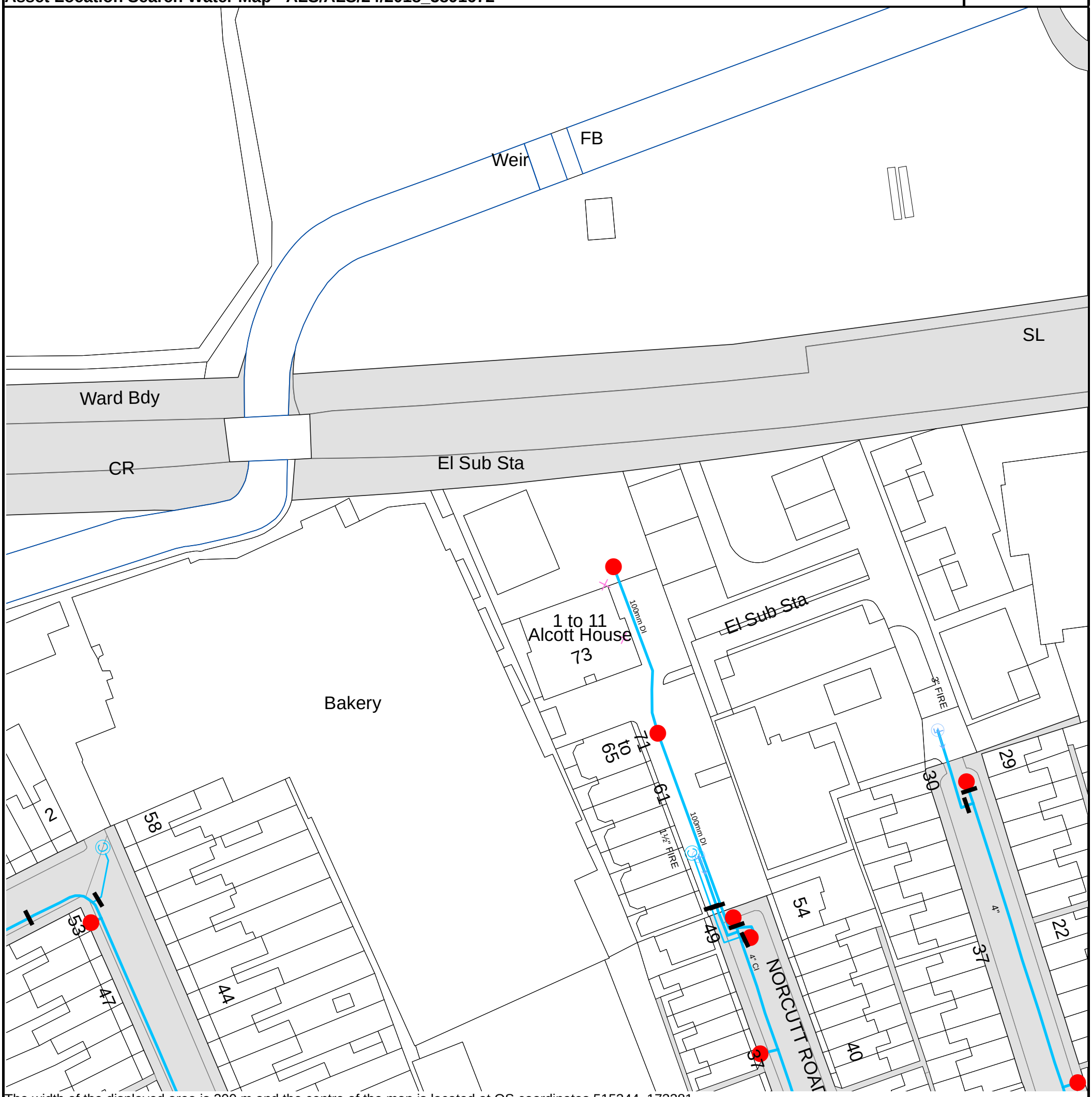
Proposed

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.

Asset Location Search Water Map - ALS/ALS/24/2018_3891672



The width of the displayed area is 200 m and the centre of the map is located at OS coordinates 515344, 173381.

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

ALS Water Map Key

Water Pipes (Operated & Maintained by Thames Water)

4"

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

16"

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

3" SUPPLY

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

3" FIRE

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

3" METERED

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

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

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

Valves

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

Hydrants

- Single Hydrant

Meters

- Meter

End Items

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

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

Operational Sites

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

Other Symbols

- Data Logger

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

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

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

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

Terms and Conditions

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

1. All goods remain in the property of Thames Water Utilities Ltd until full payment is received.
2. Provision of service will be in accordance with all legal requirements and published TWUL policies.
3. All invoices are strictly due for payment 14 days from due date of the invoice. Any other terms must be accepted/agreed in writing prior to provision of goods or service, or will be held to be invalid.
4. Thames Water does not accept post-dated cheques-any cheques received will be processed for payment on date of receipt.
5. In case of dispute TWUL`s terms and conditions shall apply.
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Ways to pay your bill

Credit Card	**BACS Payment**	**Telephone Banking**	**Cheque**
Call **0845 070 9148** quoting your invoice number starting CBA or ADS / OSS	Account number **90478703** Sort code **60-00-01** A remittance advice must be sent to: **Thames Water Utilities Ltd., PO Box 3189, Slough SL1 4WW.** or email **ps.billing@thameswater.co.uk**	By calling your bank and quoting: Account number **90478703** Sort code **60-00-01** and your invoice number	Made payable to '**Thames Water Utilities Ltd**' Write your Thames Water account number on the back. Send to: **Thames Water Utilities Ltd., PO Box 3189, Slough SL1 4WW** or by DX to **151280 Slough 13**

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TPOs Contact Details

The Property Ombudsman scheme
Milford House
43-55 Milford Street
Salisbury
Wiltshire SP1 2BP
Tel: 01722 333306
Fax: 01722 332296
Email: admin@tpos.co.uk

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Appendix E

MicroDrainage Modelling Assessment

ICP SUDS Mean Annual Flood

Input

Return Period (years)	2	Soil	0.300
Area (ha)	0.072	Urban	0.000
SAAR (mm)	600	Region Number	Region 6

Results l/s

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

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

Half Drain Time : 365 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	9.062	0.572	0.0	0.7	0.7	17.9	O K
30 min Summer	9.230	0.740	0.0	0.8	0.8	23.2	O K
60 min Summer	9.384	0.894	0.0	0.9	0.9	28.0	O K
120 min Summer	9.502	1.012	0.0	0.9	0.9	31.7	O K
180 min Summer	9.537	1.047	0.0	0.9	0.9	32.8	O K
240 min Summer	9.537	1.047	0.0	0.9	0.9	32.8	O K
360 min Summer	9.512	1.022	0.0	0.9	0.9	32.0	O K
480 min Summer	9.484	0.994	0.0	0.9	0.9	31.2	O K
600 min Summer	9.455	0.965	0.0	0.9	0.9	30.2	O K
720 min Summer	9.426	0.936	0.0	0.9	0.9	29.3	O K
960 min Summer	9.371	0.881	0.0	0.9	0.9	27.6	O K
1440 min Summer	9.270	0.780	0.0	0.8	0.8	24.5	O K
2160 min Summer	9.139	0.649	0.0	0.8	0.8	20.3	O K
2880 min Summer	9.023	0.533	0.0	0.7	0.7	16.7	O K
4320 min Summer	8.785	0.295	0.0	0.7	0.7	9.2	O K
5760 min Summer	8.658	0.168	0.0	0.7	0.7	5.3	O K
7200 min Summer	8.599	0.109	0.0	0.7	0.7	3.4	O K
8640 min Summer	8.572	0.082	0.0	0.6	0.6	2.6	O K
10080 min Summer	8.561	0.071	0.0	0.6	0.6	2.2	O K
15 min Winter	9.133	0.643	0.0	0.8	0.8	20.2	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	138.874	0.0	18.4	26
30 min Summer	90.946	0.0	24.2	40
60 min Summer	56.713	0.0	30.3	68
120 min Summer	34.162	0.0	36.6	126
180 min Summer	25.057	0.0	40.3	184
240 min Summer	19.992	0.0	42.9	240
360 min Summer	14.500	0.0	46.6	304
480 min Summer	11.545	0.0	49.5	366
600 min Summer	9.667	0.0	51.9	432
720 min Summer	8.358	0.0	53.8	500
960 min Summer	6.638	0.0	57.0	640
1440 min Summer	4.791	0.0	61.7	916
2160 min Summer	3.452	0.0	66.8	1324
2880 min Summer	2.733	0.0	70.5	1728
4320 min Summer	1.964	0.0	76.0	2420
5760 min Summer	1.552	0.0	80.2	3056
7200 min Summer	1.292	0.0	83.4	3744
8640 min Summer	1.112	0.0	86.2	4408
10080 min Summer	0.980	0.0	88.5	5136
15 min Winter	138.874	0.0	20.6	26

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

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	9.323	0.833	0.0	0.8	0.8	26.1	O K
60 min Winter	9.499	1.009	0.0	0.9	0.9	31.6	O K
120 min Winter	9.640	1.150	0.0	1.0	1.0	36.1	O K
180 min Winter	9.689	1.199	0.0	1.0	1.0	37.6	O K
240 min Winter	9.828	1.338	0.0	1.0	1.0	37.9	O K
360 min Winter	9.673	1.183	0.0	1.0	1.0	37.1	O K
480 min Winter	9.638	1.148	0.0	1.0	1.0	36.0	O K
600 min Winter	9.603	1.113	0.0	1.0	1.0	34.9	O K
720 min Winter	9.564	1.074	0.0	0.9	0.9	33.7	O K
960 min Winter	9.486	0.996	0.0	0.9	0.9	31.2	O K
1440 min Winter	9.339	0.849	0.0	0.9	0.9	26.6	O K
2160 min Winter	9.147	0.657	0.0	0.8	0.8	20.6	O K
2880 min Winter	8.974	0.484	0.0	0.7	0.7	15.2	O K
4320 min Winter	8.657	0.167	0.0	0.7	0.7	5.2	O K
5760 min Winter	8.575	0.085	0.0	0.6	0.6	2.7	O K
7200 min Winter	8.558	0.068	0.0	0.5	0.5	2.1	O K
8640 min Winter	8.549	0.059	0.0	0.5	0.5	1.8	O K
10080 min Winter	8.543	0.053	0.0	0.4	0.4	1.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	90.946	0.0	27.1	40
60 min Winter	56.713	0.0	34.0	68
120 min Winter	34.162	0.0	41.0	124
180 min Winter	25.057	0.0	45.1	180
240 min Winter	19.992	0.0	48.0	236
360 min Winter	14.500	0.0	52.3	340
480 min Winter	11.545	0.0	55.5	384
600 min Winter	9.667	0.0	58.1	462
720 min Winter	8.358	0.0	60.3	538
960 min Winter	6.638	0.0	63.9	692
1440 min Winter	4.791	0.0	69.2	988
2160 min Winter	3.452	0.0	74.8	1412
2880 min Winter	2.733	0.0	79.0	1848
4320 min Winter	1.964	0.0	85.2	2420
5760 min Winter	1.552	0.0	89.8	3000
7200 min Winter	1.292	0.0	93.5	3680
8640 min Winter	1.112	0.0	96.6	4408
10080 min Winter	0.980	0.0	99.2	5080

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.406	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.072

Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)	Time (mins) From:	To:	Area (ha)
0	4	0.024	4	8	0.024	8	12	0.024

Model Details

Storage is Online Cover Level (m) 10.300

Cellular Storage Structure

Invert Level (m) 8.490 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m²)	Inf. Area (m²)	Depth (m)	Area (m²)	Inf. Area (m²)
0.000	33.0	0.0	1.210	0.0	0.0
1.200	33.0	0.0			

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0045-1000-1200-1000
Design Head (m)	1.200
Design Flow (l/s)	1.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	45
Invert Level (m)	8.500
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	1.0
Flush-Flo™	0.196	0.7
Kick-Flo®	0.398	0.6
Mean Flow over Head Range	-	0.8

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

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	0.7	1.200	1.0	3.000	1.5	7.000	2.2
0.200	0.7	1.400	1.1	3.500	1.6	7.500	2.3
0.300	0.7	1.600	1.1	4.000	1.7	8.000	2.4
0.400	0.6	1.800	1.2	4.500	1.8	8.500	2.4
0.500	0.7	2.000	1.3	5.000	1.9	9.000	2.5
0.600	0.7	2.200	1.3	5.500	2.0	9.500	2.6
0.800	0.8	2.400	1.4	6.000	2.1		
1.000	0.9	2.600	1.4	6.500	2.2		

Our ref: HLEF68721/002 L

35 New Bridge Street
London, EC4V 6BW
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Date: 11th June 2019

Site Information

1.1 The application site is located at Lockcorp House, 75 Norcutt Road, Twickenham, TW2 6SR and is centred at National Grid Reference 515324 173333. The site extends to approximately 0.07 ha.

Design Rainfall

1.2 The rainfall used to derive the surface water runoff rates and volumes was obtained from the Flood Estimation Handbook (FEH) Web Service[1], depth-duration-frequency model. This provides design rainfall intensities for a range of return periods and storm durations, which are presented in Table 1.

Table 1 - Design Rainfall Depth (mm)

	Storm Durations (hr)								
	0.25	**0.5**	**1**	**2**	**3**	**5**	**12**	**24**	**48**
1	5.89	7.49	9.19	14.36	17.47	21.18	26.54	30.46	35.55
2	8.87	11.23	13.75	19.94	23.56	27.79	33.85	38.23	43.91
5	13.12	16.57	20.25	27.58	31.76	36.62	43.46	48.38	54.62
10	16.29	20.79	25.41	33.49	38.12	43.43	50.83	56.08	62.66
30	21.53	27.7	34.03	43.43	48.85	55.09	63.64	69.44	76.42
50	24.1	31.12	38.33	48.58	54.52	61.42	70.81	76.91	83.94
100	27.86	36.13	44.64	56.5	63.62	72.03	83.48	90.26	96.92
100+5%	29.25	37.94	46.87	59.33	66.80	75.63	87.65	94.77	101.77
100+10%	30.65	39.74	49.10	62.15	69.98	79.23	91.83	99.29	106.61
100+20%	33.43	43.36	53.57	67.80	76.34	86.44	100.18	108.31	116.30
100+30%	36.22	46.97	58.03	73.45	82.71	93.64	108.52	117.34	126.00
100+40%	39.00	50.58	62.50	79.10	89.07	100.84	116.87	126.36	135.69

[1] **Centre for Ecology & Hydrology (2016), Flood Estimation Handbook (FEH)** [Accessed online on 03/06/2019 at https://fehweb.ceh.ac.uk/]

Climate Change

1.3 Climate change is currently predicted to increase the wetness of winters and the dryness of summers. The intensity of storm events is anticipated to increase with rises of 5% expected by 2025, 10% by 2055, 20% by 2085 and 40% by 2115. This will have an impact on the volume of rainfall that will fall at the site, with rainfall increasing from 27.86 mm for the 1% AEP storm, with duration of 15 minutes, to 39.00 mm for the 1% AEP storm plus 40%.

Existing Surface Water Runoff Rates

1.4 It has been assumed that the site currently consists entirely of impermeable area of approximately of 711 m^2.

1.5 The Wallingford Modified Rational Method has been used to estimate the surface water runoff generated during peak rainfall events based on the nature of the ground surface (hard standing, vegetation, etc) and rainfall depth, duration and frequency information for the immediate area. A runoff coefficient of 1 was applied for the whole area in line with best practise for surface water runoff estimation.

1.6 The results of this calculation for a range of return periods, including climate change, are presented in Table 2.

Table 2 – Existing Surface Water Runoff Rates (l/s)

	Storm Durations (hr)								
	0.25	**0.5**	**1**	**2**	**3**	**5**	**12**	**24**	**48**
1	4.7	3.0	1.8	1.4	1.2	0.8	0.4	0.3	0.1
2	7.1	4.5	2.7	2.0	1.6	1.1	0.6	0.3	0.2
5	10.4	6.6	4.0	2.7	2.1	1.5	0.7	0.4	0.2
10	13.0	8.3	5.1	3.3	2.5	1.7	0.8	0.5	0.3
30	17.1	11.0	6.8	4.3	3.2	2.2	1.1	0.6	0.3
50	19.2	12.4	7.6	4.8	3.6	2.4	1.2	0.6	0.3
100	22.2	14.4	8.9	5.6	4.2	2.9	1.4	0.7	0.4
100+5%	23.3	15.1	9.3	5.9	4.4	3.0	1.5	0.8	0.4
100+10%	24.4	15.8	9.8	6.2	4.6	3.2	1.5	0.8	0.4
100+20%	26.6	17.3	10.7	6.7	5.1	3.4	1.7	0.9	0.5
100+30%	28.8	18.7	11.5	7.3	5.5	3.7	1.8	1.0	0.5
100+40%	31.1	20.1	12.4	7.9	5.9	4.0	1.9	1.0	0.6

1.7 As presented, the estimated 1 in 1 year, 15 minutes run-off rate for the existing development is approximately 4.7 litres per second (l/s), whilst the 100-year, 15 minutes run-off is 22.2 l/s. The currently expected impacts of climate change based on the year 2119 (assuming an expected lifespan of the development of at least 100 years) would increase this to 31.1 l/s for the site.

1.8 The surface water runoff volume for the existing site are presented in Table 3.

Table 3 – Existing Surface Water Runoff Volume (m^3)

	Storm Durations (hr)								
	0.25	0.5	1	2	3	5	12	24	48
1	4.2	5.4	6.6	10.3	12.5	15.2	19.0	21.8	25.5
2	6.4	8.0	9.9	14.3	16.9	19.9	24.3	27.4	31.5
5	9.4	11.9	14.5	19.8	22.8	26.2	31.1	34.7	39.1
10	11.7	14.9	18.2	24.0	27.3	31.1	36.4	40.2	44.9
30	15.4	19.8	24.4	31.1	35.0	39.5	45.6	49.8	54.8
50	17.3	22.3	27.5	34.8	39.1	44.0	50.7	55.1	60.1
100	20.0	25.9	32.0	40.5	45.6	51.6	59.8	64.7	69.4
100+5%	21.0	27.2	33.6	42.5	47.9	54.2	62.8	67.9	72.9
100+10%	22.0	28.5	35.2	44.5	50.1	56.8	65.8	71.1	76.4
100+20%	24.0	31.1	38.4	48.6	54.7	61.9	71.8	77.6	83.3
100+30%	25.9	33.7	41.6	52.6	59.3	67.1	77.8	84.1	90.3
100+40%	27.9	36.2	44.8	56.7	63.8	72.3	83.7	90.5	97.2

Proposed Surface Water Runoff Rates

1.9 Following the development at the site it is expected that the impermeable area will be reduced to 598 m^2 and landscaped (permeable) area of 113 m^2 will be introduced. A runoff coefficient of 1 and 0.3 was applied for the impermeable and permeable areas respectively in line with best practise for surface water runoff estimation.

1.10 The results of this calculation for a range of return periods, including climate change, are presented in Table 4.

Table 4 – Proposed Surface Water Runoff Rates (l/s)

	Storm Durations (hr)								
	0.25	0.5	1	2	3	5	12	24	48
1	4.2	2.6	1.6	1.3	1.0	0.7	0.4	0.2	0.1
2	6.3	4.0	2.4	1.8	1.4	1.0	0.5	0.3	0.2
5	9.3	5.9	3.6	2.4	1.9	1.3	0.6	0.4	0.2
10	11.5	7.4	4.5	3.0	2.2	1.5	0.7	0.4	0.2
30	15.2	9.8	6.0	3.8	2.9	1.9	0.9	0.5	0.3
50	17.1	11.0	6.8	4.3	3.2	2.2	1.0	0.6	0.3
100	19.7	12.8	7.9	5.0	3.8	2.5	1.2	0.7	0.4
100+5%	20.7	13.4	8.3	5.2	3.9	2.7	1.3	0.7	0.4

100+10%	21.7	14.1	8.7	5.5	4.1	2.8	1.4	0.7	0.4
100+20%	23.7	15.3	9.5	6.0	4.5	3.1	1.5	0.8	0.4
100+30%	25.6	16.6	10.3	6.5	4.9	3.3	1.6	0.9	0.5
100+40%	27.6	17.9	11.1	7.0	5.3	3.6	1.7	0.9	0.5

1.11 As presented, the estimated 1 in 1 year, 15 minutes run-off rate for the proposed development is approximately 4.2 litres per second (l/s), whilst the 100-year, 15 minutes run-off is 19.7 l/s. The currently expected impacts of climate change based on the year 2119 (assuming an expected lifespan of the development of at least 100 years) would increase this to 27.6 l/s for the site.

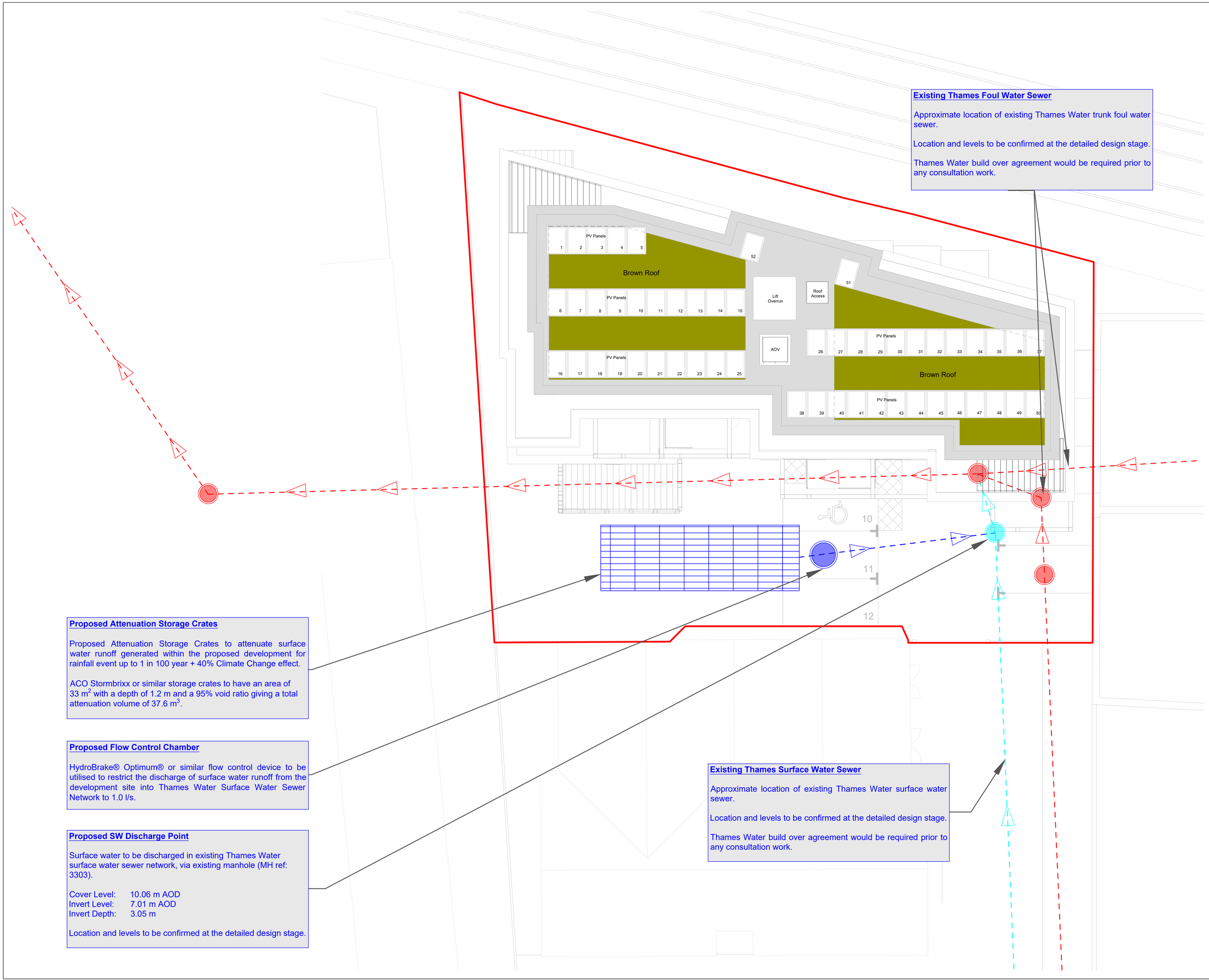
1.12 The surface water runoff volume for the existing site are presented in Table 5.

Table 5 – Proposed Surface Water Runoff Volume (m^3)

	Storm Durations (hr)								
	0.25	**0.5**	**1**	**2**	**3**	**5**	**12**	**24**	**48**
1	3.8	4.8	5.9	9.1	11.1	13.5	16.9	19.4	22.6
2	5.6	7.2	8.8	12.7	15.0	17.7	21.6	24.3	28.0
5	8.4	10.6	12.9	17.6	20.2	23.3	27.7	30.8	34.8
10	10.4	13.2	16.2	21.3	24.3	27.7	32.4	35.7	39.9
30	13.7	17.6	21.7	27.7	31.1	35.1	40.5	44.2	48.7
50	15.3	19.8	24.4	30.9	34.7	39.1	45.1	49.0	53.5
100	17.7	23.0	28.4	36.0	40.5	45.9	53.2	57.5	61.7
100+5%	18.6	24.2	29.8	37.8	42.5	48.2	55.8	60.4	64.8
100+10%	19.5	25.3	31.3	39.6	44.6	50.5	58.5	63.2	67.9
100+20%	21.3	27.6	34.1	43.2	48.6	55.0	63.8	69.0	74.1
100+30%	23.1	29.9	37.0	46.8	52.7	59.6	69.1	74.7	80.2
100+40%	24.8	32.2	39.8	50.4	56.7	64.2	74.4	80.5	86.4

Appendix F

Conceptual Surface Water Drainage Layout



Notes

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2. No dimensions are to be scaled from this drawing.
3. Drawing is based on *5076_3_A-Site Plan.dwg* provided by Brookes Architects Ltd.
4. Surface water Drainage Strategy design to convey and store runoff generated by rainfall event of up to 1 1in 100 year + 40% Climate Change.
5. Surface Water runoff generated on site will be discharged into existing Thames Water surface water sewer located at the site. The sewer is shown to be flowing in a northerly direction from south to north of the site. The runoff will be limited using a flow control chamber to 1.0l/s.

Key

- Site boundary
- Existing Thames Surface Water Network
- Existing Thames Foul Water Network
- Proposed Surface Water Drainage
- Proposed Geo-cellular Storage Crates

Rev	Description	By	CB	Date
A	For Planning	GB	RR	07/06/19

MAKING COMPLEX EASY
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Client: Leek Real Estate Ltd.

Project: 75 Norcutt Road
TW2 6SR

Title: Conceptual Surface Water Attenuation Plan

Status	Drawn By	PM/Checked by
For Planning	GB	RR

Project Number	Scale @ A1	Date Created
HLEF68721	NTS	07/06/2019

RPS Drawing / Figure Number: HLEF68721-D001

Rev: A

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Appendix G

SuDS Maintenance Plan

SuDS Maintenance Plan

This Maintenance Plan has been produced in order to ensure that the SuDS incorporated at the site remain functional for the lifetime of the development. This will ensure a continued reduction in local flood risk through the attenuation of surface water run-off on-site. It is proposed to provide underground geo-cellular storage crates capable of reducing the discharge rate to 1 l/s. This plan demonstrates that the maintenance and operation requirements of the SuDS are economically proportionate to the development.

Type of SuDS	Illustration	Maintenance Required	Regularity	Indicative Cost
Underground Attenuation Crates	 Underground plastic geocellular / modular systems can be used to create a below ground storage structure. Due to the modular nature of the systems, they can be tailored to suit the specific requirements of any site. Water can be attenuated on site, before discharging at a controlled rate to a watercourse or other drainage system.	Cleaning inlets / outlets, manholes, associated pipework and silt traps	Annual, or as required	c.£200 - £500

This document was compiled with reference to the Ciria Susdrain website, the CIRIA SuDS Manual (2015) and to 'Cost estimation for SUDS - summary of evidence' (Environment Agency, March 2015) and references therein.

Appendix H

Richmond SuDS Proforma

LONDON BOROUGH OF RICHMOND UPON THAMES

GREATER**LONDON**AUTHORITY

LoDEG

1. Project & Site Details

Project / Site Name (including sub-catchment / stage / phase where appropriate)	75 Norcutt Road
Address & post code	75 Norcutt Road, Twickenham, TW2 6SR
OS Grid ref. (Easting, Northing)	E 515343
	N 173383
LPA reference (if applicable)	
Brief description of proposed work	Demolition and redevelopment to provide 15 residential flats, parking and communal area
Total site Area	711 m^2
Total existing impervious area	711 m^2
Total proposed impervious area	598 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	Surface water sewer beneath site - Thames Water manhole reference 3303
Designer Name	George Butcher
Designer Position	Consultant
Designer Company	RPS

2. Proposed Discharge Arrangements

2a. Infiltration Feasibility

Superficial geology classification	Kempton Park Gravel Formation
Bedrock geology classification	London Clay Formation
Site infiltration rate	N/A m/s
Depth to groundwater level	>4 m below ground level
Is infiltration feasible?	No

2b. Drainage Hierarchy

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

2c. Proposed Discharge Details

Proposed discharge location	Surface water sewer beneath site - Thames Water manhole reference 3303
Has the owner/regulator of the discharge location been consulted?	Yes and a response is awaited

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	0.1			
1 in 1	0.1	4.7		1
1 in 30	0.2	17.1		1
1 in 100	0.3	22.2		1
1 in 100 + CC			37.6	1
Climate change allowance used		40%		
3b. Principal Method of Flow Control		Hydrobrake		

3c. Proposed SuDS Measures

	Catchment area (m^2)	*Plan area (m^2)*	*Storage vol. (m^3)*
Rainwater harvesting	0		0
Infiltration systems	0		0
Green roofs	0	0	0
Blue roofs	0	0	0
Filter strips	0	0	0
Filter drains	0	0	0
Bioretention / tree pits	0	0	0
Pervious pavements	0	0	0
Swales	0	0	0
Basins/ponds	0	0	0
Attenuation tanks	711		37.9
Total	**711**	**0**	**37.9**

4. Supporting Information

4a. Discharge & Drainage Strategy	*Page/section of drainage report*
Infiltration feasibility (2a) – geotechnical factual and interpretive reports, including infiltration results	Section 8 details geology and groundwater information
Drainage hierarchy (2b)	Section 10
Proposed discharge details (2c) – utility plans, correspondence / approval from owner/regulator of discharge location	Approval awaited Sewer plans in Appendix D
Discharge rates & storage (3a) – detailed hydrologic and hydraulic calculations	Section 10 and Appendix E
Proposed SuDS measures & specifications (3b)	Section 10 and Appendix F
4b. Other Supporting Details	*Page/section of drainage report*
Detailed Development Layout	Section 5 and Appendix C
Detailed drainage design drawings, including exceedance flow routes	Appendices F and I
Detailed landscaping plans	N/A
Maintenance strategy	Appendix G
Demonstration of how the proposed SuDS measures improve:	Section 10
a) water quality of the runoff?	24
b) biodiversity?	24
c) amenity?	24

Appendix I

Flow Exceedance Plan

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Key

- Site Boundary
- Proposed Building Footprint
- Overland Flow Exceedence Route

Rev	Description	By	CB	Date
A	For Planning	NW	RR	11/06/19

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Client: Leek Real Estate Ltd.

Project: 75 Norcutt Road
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Title: Surface Water Runoff Flow Exceedance Route

Status	Drawn By	PM/Checked by
For Planning	NW	RR

Project Number	Scale @ A1	Date Created
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