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FLOOD RISK ASSESSMENT
& DRAINAGE STRATEGY REPORT

PROPOSED RESIDENTIAL DEVELOPMENT
ST MARGARET'S BUSINESS CENTRE
MOOR MEAD ROAD
TWICKENHAM
TW1 1JS

PREPARED FOR: Sheen Lane Developments Ltd

JOB NO: P20-435A

DATE: 11 March 2022

ISSUE NO: 1

DOCUMENT HISTORY

Issue No.	Description	Date
1	Issue for comment.	11/03/22

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1. INTRODUCTION

1.1 This report has been prepared on behalf of Sheen Lane Developments Ltd to accompany a planning application for a proposed residential development at St Margaret's Business Car Park in Moor Mead Road, Twickenham.

1.2 The report assesses flood risk associated with the development proposals, closely following guidance set out in the National Planning Policy Framework (NPPF), the associated Planning Practice Guidance, Policy LP 21 (Flood Risk & Sustainable Drainage) of the London Borough of Richmond Adopted Local Plan and the London Borough of Richmond upon Thames Strategic Flood Risk Assessment – Level 1 Update (March 2021).

1.3 The report also details a strategy for the disposal of foul and surface water runoff from the development, closely following guidance on sustainable drainage set out in the London Sustainable Drainage Proforma that was adopted by the London Borough of Richmond upon Thames in April 2019.

2. SITE LOCATION AND CHARACTERISTICS

<u>Site Location</u>

2.1 The site is located at St Margaret's Business Park in Moormead Road Twickenham, TW1 1JS as shown on *Figure 1* below. The site is centred on Ordnance Survey grid reference TQ 16645 74123 and co-ordinates X: 516645, Y: 174123.

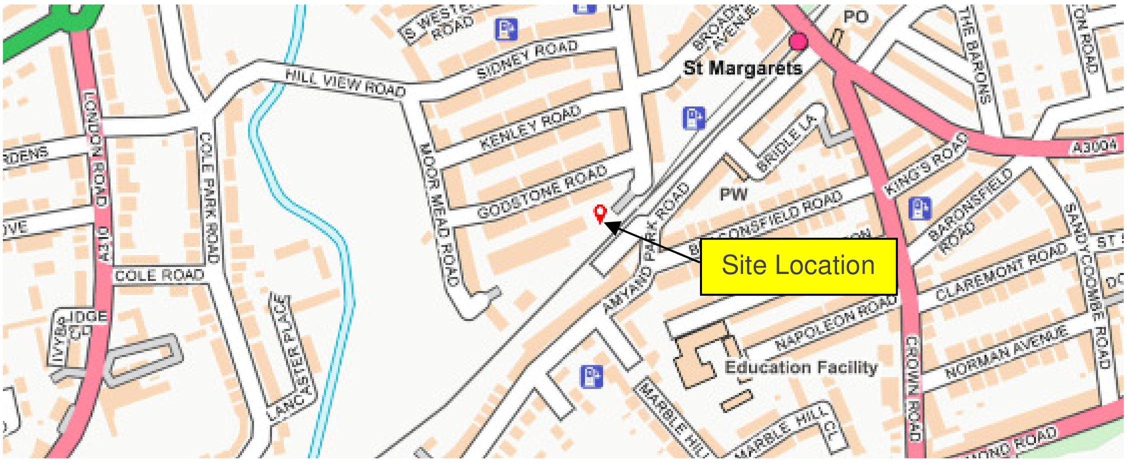


Figure 1: Site Location

<u>Site Description</u>

2.2 The sites measured area is approximately 0.06 Ha and presently comprises of a parking area as shown on the topographical survey included in *Appendix A*.

<u>Topography</u>

2.3 The topographical survey included in *Appendix A*, shows site levels to be between 6.00mAOD to 6.40mAOD.

Existing Ground Conditions

2.4 *Figure 2* and *Figure 3* below have been taken from the British Geological Survey website and show the superficial geology of the local area to comprise of the Kempton Park Gravel Member, while the bedrock geology is shown to comprise the London Clay Formation. The Kempton Park Gravel Member is indicated to comprise of Sands and Gravels while the London Clay Formation is indicated to comprise of Clays and Silts.

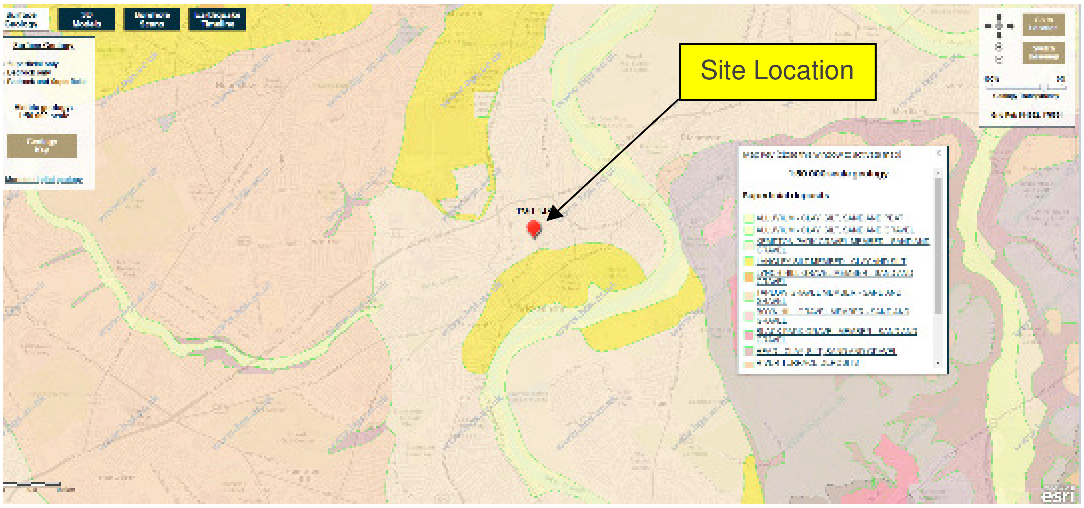


Figure 2: BGS Superficial Geology Map

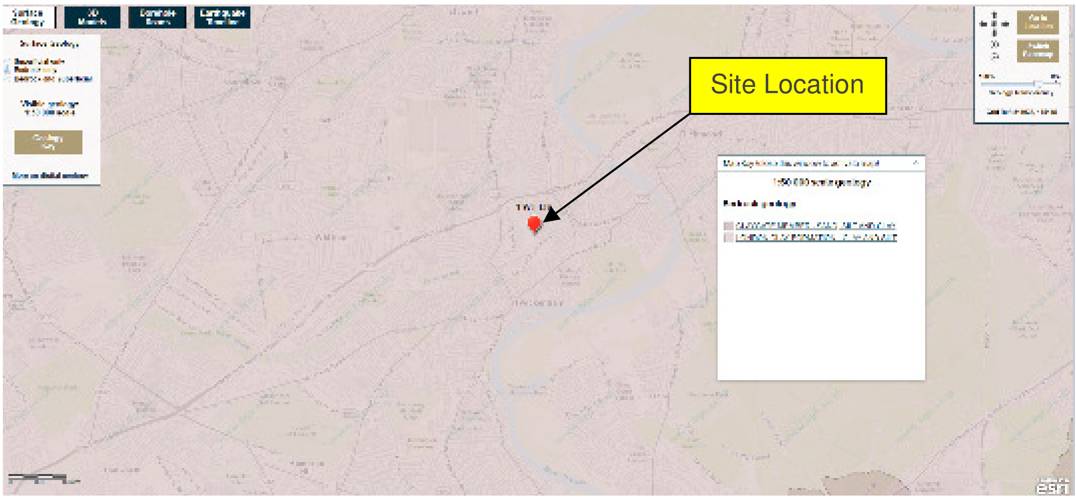


Figure 3: Bed Rock Geology Map

Existing Drainage Arrangements

2.5 *Figure 5* below shows an extract from sewer records provided by Thames Water. The extract shows the local area to be drained by a network of foul and surface water networks present in the surrounding road network.

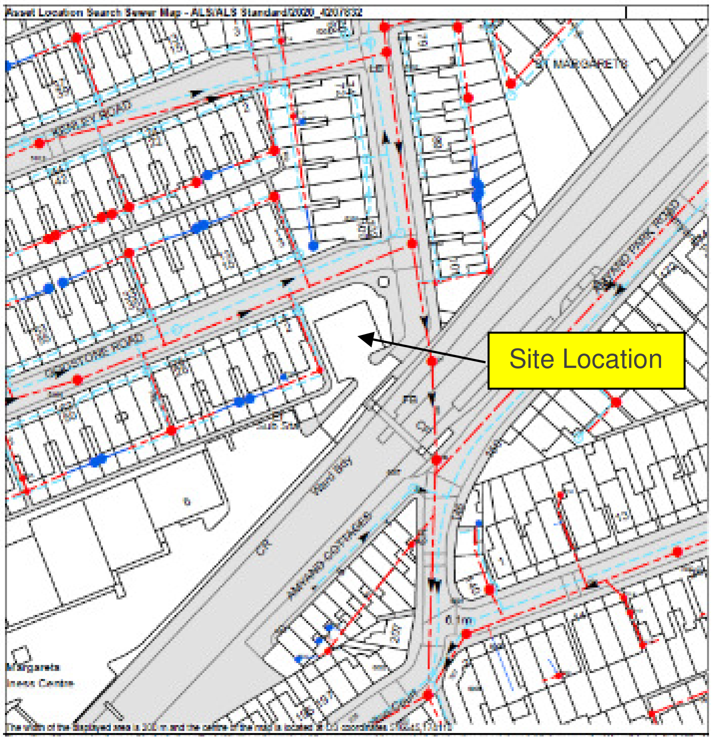


Figure 4: Thames Water Sewer Records

2.6 The topographical survey included in *Appendix A* shows the existing car park to be drained by a dished channel and road gullies.

3. PROPOSED SCHEME

3.1 The proposed development comprises 3 No. residential dwellings with associated gardens and parking spaces.

3.2 A set of drawings illustrating the development proposals is included in *Appendix B*.

4. FLOOD RISK POLICY & GUIDANCE

4.1 At a national level, the National Planning Policy Framework (NPPF) and the Planning Practice Guidance (PPG) to the NPPF ensure flood risk is taken into account at all stages of the planning process, to avoid inappropriate development in areas at risk of flooding and to direct development towards areas at lowest flood risk. The NPPF retains a risk-based approach to the planning process and defines four Flood Zones to be used as the basis for applying the sequential test, as well as flood risk vulnerability classifications, which define the type of development that is considered appropriate within each zone.

4.2 The NPPF establishes the Flood Zones as the starting point for assessment with the overarching aim to steer new development to areas with the lowest probability of flooding. Flood Zone maps are available on the GOV.UK website and the definitions of the Flood Zones extracted from the National Planning Policy Framework (NPPF) are described below:

- Flood Zone 1 – Low probability. This zone comprises land assessed as having a less than 1 in 1,000 annual probability of river or sea flooding (<0.1%).

- Flood Zone 2 – Medium probability. This zone comprises land assessed as having between a 1 in 100 and 1 in 1,000 annual probability of river flooding (1% - 0.1%), or between a 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.5% - 0.1%) in any year.

- Flood Zone 3a – High probability. This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%), or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.

- Flood Zone 3b – The functional floodplain. This zone comprises land where water has to flow or be stored in times of flood. Typically, land which would flood with an annual probability of 1 in 20 (0.5%) or greater in any year, or is designed to flood in an extreme (0.1%) flood.

4.3 Policy LP 21 (Flood Risk & Sustainable Drainage) of Richmond upon Thames Adopted Local Plan adopts similar principles to the NPPF and identifies that Level 1 Strategic Flood Risk Assessment should be used to inform site specific flood risk assessments in the district. The following section of this report reviews flood risk associated with sources of flooding identified within the Level 1 SFRA and the EA's online flood risk maps.

5. SOURCES OF FLOODING

Fluvial Flooding

5.1 The flood zone map in *Figure 5* below has been taken from EA's website and shows the site to be in Flood Zone 2 associated with the River Crane.

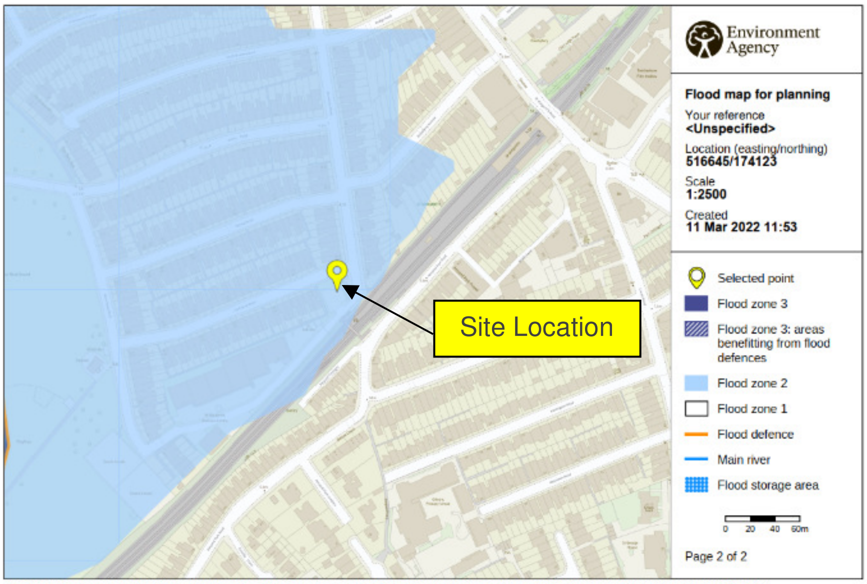


Figure 5: EA Flood Zone Map

5.2 The risk of river / tidal flood map taken from the EA's website in *Figure 6* below shows the shows the risk of fluvial flooding to be low.

Figure 6: EA Risk of Fluvial / Tidal Flooding Map

5.3 The flood zone map in *Figure 7* below has been generated from interactive mapping developed to accompany the Level 1 SFRA. The map shows the flood zones to be consistent with the EA flood zone with the site shown to be in Flood Zone 2. The site is also shown to be in an EA flood alert area.

Figure 7: Level 1 SFRA Flood Zone Map

5.4 The flood zone maps available on the EA's website and within the SFRA are produced from a combination of a national generalised computer model, detailed modelling and some historic flood event outlines and are intended as a guide only. More detailed flood data received from the EA is included in *Appendix C*.

5.5 The data received from the EA includes a set of flood maps for various Annual Exceedance Probabilities (AEP) at a number of modelled floodplain nodes within and surrounding the site. The maps are shown in *Figure 8, Figure 9* and *Figure 10* below.

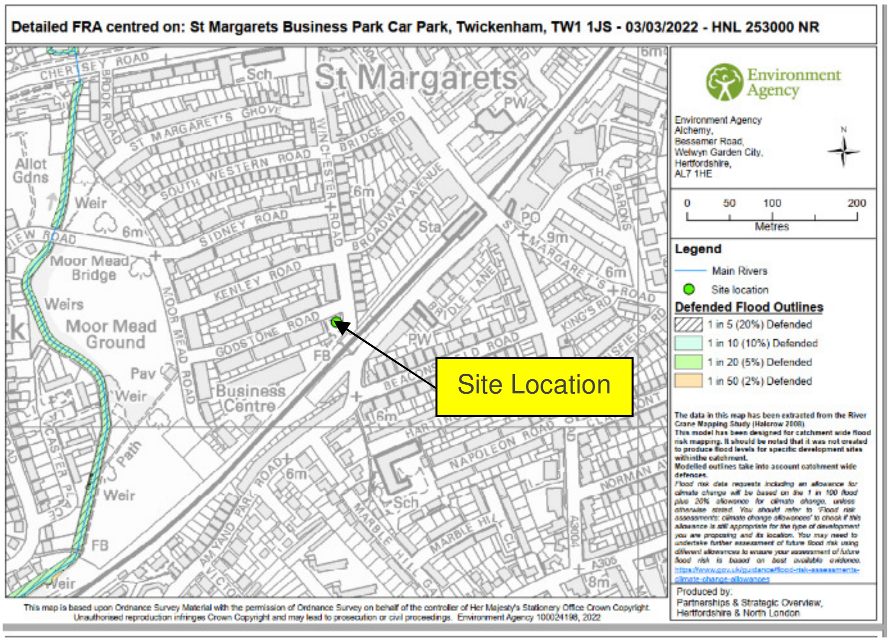


Figure 8: Defended Flood Outline Map 1

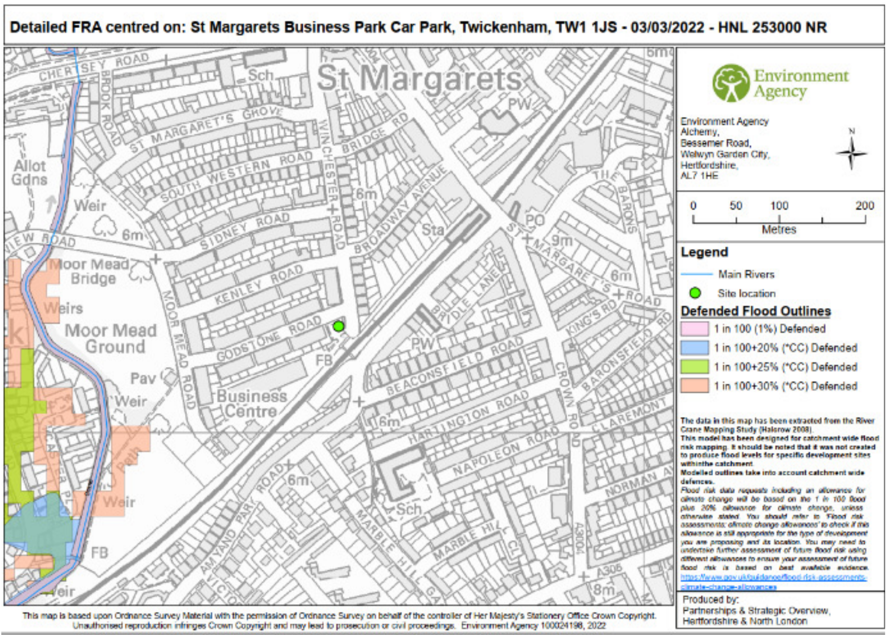


Figure 9: Defended Flood Outline Map 2

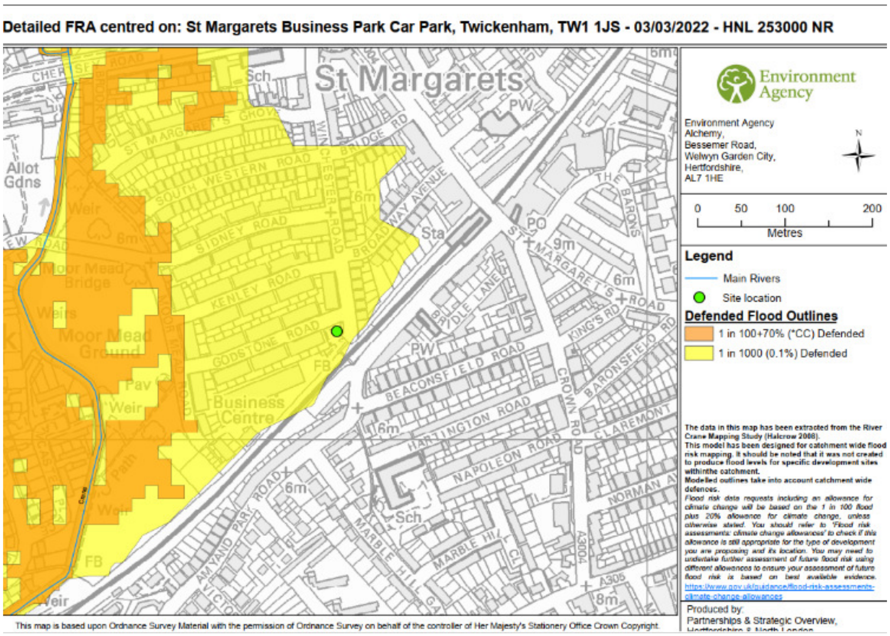


Figure 10: Defended Flood Outline Map 3

5.6 *Figure 8*, *Figure 9* and *Figure 10* show the site and immediate surrounding area to be unaffected by the 1% plus climate change AEP's but within the flood outline associated with the 0.1% AEP. *Figure 11* below shows the predicted flood level associated with the 0.1% AEP to be 6.34mAOD at the site.

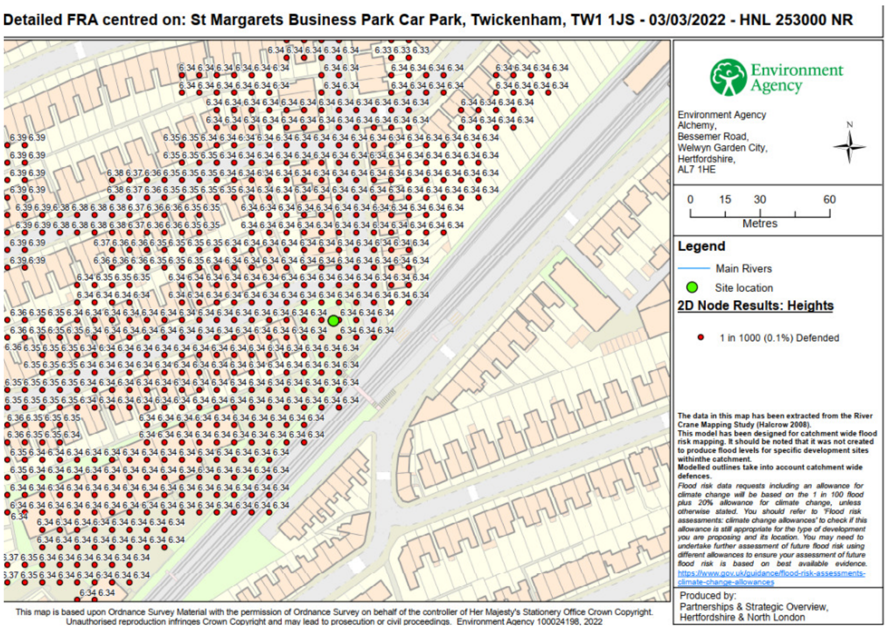


Figure 11: 0.1% AEP Defended Flood Levels

<u>Surface Water Flooding</u>

5.7 The EA have modelled locations along critical flow paths and areas situated in topographic depressions, which could flood following an extreme rainfall event. *Figure 12* below, shows a surface water flood risk map taken from the EA's website with the location of the site identified.

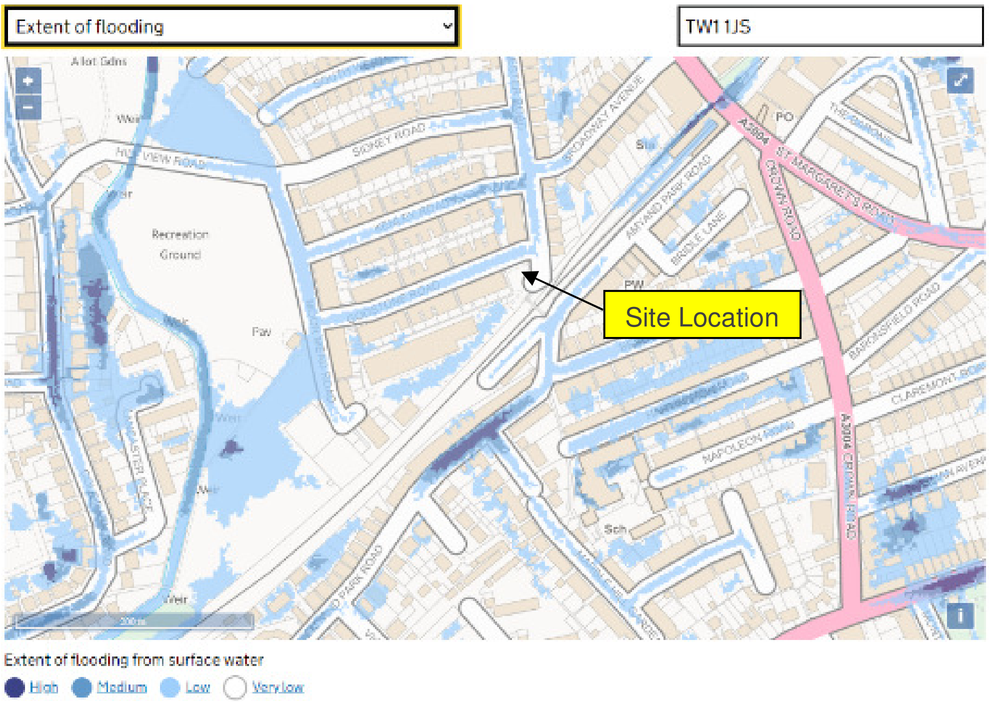


Figure 12: EA Surface Water Flood Risk Map

5.8 *Figure 12* indicates the site to not be affected by surface water flooding. Figure 13 below, shows a surface water flood risk map generated from interactive mapping developed to accompany the Level 1 SFRA. The map shows the site to not be affected by surface water indicated for up to a 1 in 1000 year event.

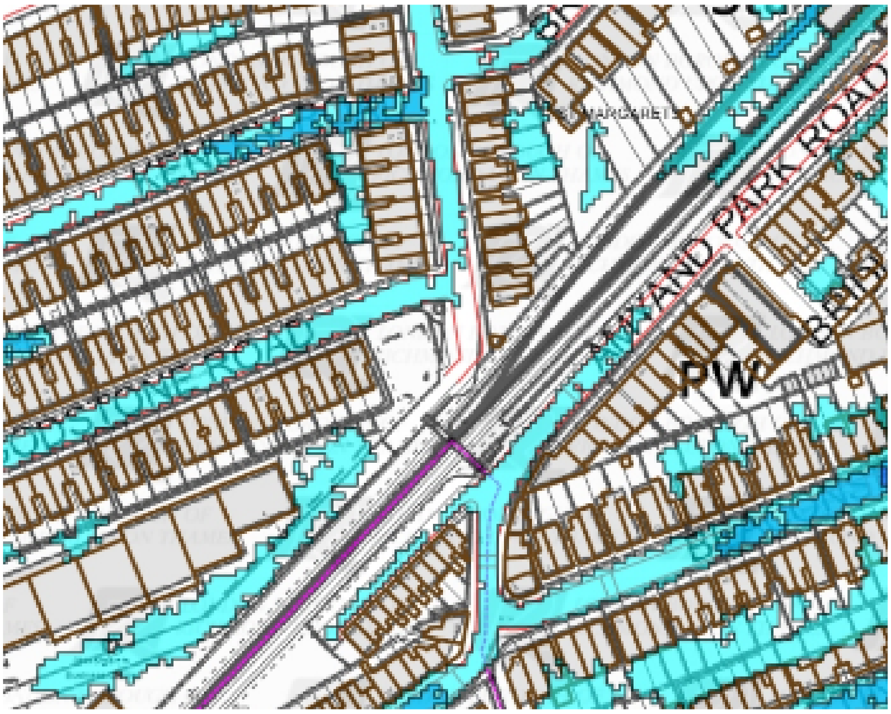


Figure 13: Level 1 Surface Water Flood Risk Map

Groundwater Flooding

5.9 The Susceptibility to Groundwater Flooding Map in *Figure 14* below has been generated from interactive mapping developed to accompany the Level 1 SFRA. The map shows the site to be located in an area where there is potential for groundwater flooding to occur at the surface.

Figure 14: SFRA Susceptibility to Groundwater Flooding Map

Sewer Flooding

5.10 The Sewer Flooding Incidents Map in *Figure 15* below has been generated from interactive mapping developed to accompany the Level 1 SFRA. The map shows the local post code to be an area where there have been between 0 to 10 incidents of sewer flooding have been reported.

Figure 15: SFRA Sewer Flooding Incidents Map

5.11 Correspondence received from Thames Water is included in *Appendix D*, which advises that there have been no incidents of flooding at the site as a result of surcharging public sewers.

5.12 The correspondence also confirms that the existing foul sewer network would have sufficient capacity for foul water flows from the development and that Thames Water would accept the discharge of surface water runoff from the development to the surface water sewer network at a rate of 2.0 l/s if it is not possible to discharge runoff by infiltration or to a watercourse.

Flooding from Artificial Sources

5.13 Flooding from artificial sources, is most likely to result from burst water mains or from infrastructure failure in an artificial watercourse or water body, i.e. canals or other water features such as reservoirs.

5.14 Flood maps associated with large reservoirs that hold over 25,000 cubic meters of water are available on the EA website. The maps help to identify areas that could potentially be affected by reservoir flooding and display a realistic worst case scenario of the largest area that may be flooded if a reservoir were to fail and release the water it holds.

5.15 *Figure 16* below shows a Reservoir Flood Map taken from the EA's website. The map shows the site to be at risk of flooding from reservoirs.

Figure 16: EA Reservoir Flood Map

5.16 The risk of failure of reservoirs is low as they are maintained, improved and regularly inspected by Thames Water.

5.17 Flood patterns associated with burst water mains would be similar to surface water flood patterns, which have been assessed to be low.

6. THE SEQUENTIAL & EXCEPTION TEST

6.1 The National Planning Policy Framework (NPPF) encourages a sequential risk-based approach to determine the suitability of land for development in flood risk areas. It advises local planning authorities to demonstrate that there are no reasonably available sites in areas with a lower probability of flooding that would be appropriate to the type of development or land use proposed.

6.2 In areas at risk of river flooding, NPPF advises that preference be given to new development in Flood Zone 1. If there are no reasonably available sites in Flood Zone 1 the flood vulnerability of the development can be considered in locating development in Flood Zone 2 and then Flood Zone 3. Within each flood zone new development should be directed to sites at the lowest probability of flooding from all sources.

6.3 In Section 5 it was established that the site lies in Flood Zone 2. The NPPF and Local Policy of the London Borough of Richmond upon Thames advises that residential developments are a more vulnerable use and appropriate in Flood Zone 2 provided they pass the sequential test with it not being necessary to apply the exception test.

7. MANAGING THE RISK OF FLOODING

7.1 Section 5 established the site to be in Flood Zone 2, which is an area assessed to be at medium probability of flooding from the River Crane. The site-specific requirements for flood risk assessments within Flood Zone 2 from the Level 1 SFRA are outlined below.

- For all sites within Zone 2 Medium Probability, a high-level FRA should be prepared based upon readily available existing flooding information, sourced from the EA. It will be necessary to demonstrate that the residual risk of flooding to the property is effectively managed through, for example, the provision of raised floor levels and the provision of a planned evacuation route and / or safe haven.

- The risk of other sources of flooding (e.g. urban drainage and/or groundwater) must be considered, and sustainable urban drainage techniques must be employed to ensure no worsening to existing flooding problems elsewhere within the area.

- As part of the high-level FRA, the developer must provide a clear and concise statement summarising how the proposed (re)development has contributed to a positive reduction in flood risk within the Borough.

- 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 rates. Any SuDS design must take due account of groundwater and geological conditions.

7.2 The measures summarised under the headings below sets out recommendations on how the development could comply with these requirements.

Floor Levels

7.3 It is recommended that that the residual risk of flooding to the property is effectively managed by setting proposed buildings ground floor levels above the predicted flood level of 6.34mAOD for the 0.1% AEP.

Access / Egress

7.4 The flood outline maps provided by the Environment Agency for the 1% plus climate change AEP's showed the site and immediate surrounding area to not be affected by flooding associated with such events. Therefore access / egress routes are not expected to be compromised in such conditions. There would be a residual risk of access / egress routes been compromised by flood events exceeding the 1% plus climate change event, however, the raised floor levels would ensure that the dwellings provide a safe haven for residents in such conditions.

Other sources

7.5 Raising the proposed buildings floor level would largely address the risk of flooding from other sources. However, National and Local Policy requires development to seek opportunities to reduce the overall level of flood risk in the area and beyond through the use of Sustainable Drainage Systems (SuDS). The following section of this report sets out a strategy for the management of surface water runoff from the development using SuDS.

8. SURFACE WATER MANAGEMENT & DRAINAGE STRATEGY

8.1 This section of the report outlines an approach for the disposal and management of surface water runoff from the development, with it expected that any further details of the strategy could be provided via a condition of the planning permission once detailed design information and construction drawings are available for the relevant phase of the development.

Surface Water Drainage Policy & Guidance

8.2 The London Borough of Richmond upon Thames are one of London's 33 Lead Local Flood Authorities (LLFA's) that have adopted the London Sustainable Drainage (SuDS) Proforma.

8.3 SuDS encompass a wide range of drainage techniques intended to minimise the rate of discharge, volume and environmental impact of runoff and include; blue / green roofs; rainwater harvesting; soakaways / infiltration systems / infiltration trenches / permeable paving; swales / basins / ponds / wetlands / below ground attenuation tanks.

8.4 The proforma advises that drainage strategies for developments in the London Borough of Richmond upon Thames need to comply with the following policies on SuDS:

- London Borough of Richmond upon Thames Local Plan policy LP21
- London Plan policy 5.13 and draft New London Plan policy SI13
- The National Planning Policy Framework (NPPF)

8.5 Section C of policy LP21 advises the following:

- 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:

    a) A reduction in surface water discharge to greenfield run-off rates wherever feasible.
    b) 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.

8.6 Section 6.2.22 of policy LP 21 advises that to reduce the risk of surface water and sewer flooding, all development proposals in the borough that could lead to changes to, and have impacts on, surface water run-off are required to follow the London Plan drainage hierarchy. The London Plan policy 5.13 advises the following:

- Development should utilise 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:

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

- 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

8.7 The Sustainable Design & Construction Supplementary Planning Guidance (SPG) document provides further guidance on the implementation of London Plan policy. Chapter 3 of the SPG advises that London Plan policy recommends that developers should aim for a greenfield runoff rate from their developments with greenfield runoff rates defined as the runoff rates from a site, in its natural state, prior to any development. However, the SPG notes that runoff rates should not be more than three times the calculated greenfield rate on previously developed sites. The only exceptions to this, where greater discharge rates may be acceptable, are where a pumped discharge would be required to meet the standards or where surface water drainage is to tidal waters and therefore would be able to discharge at unrestricted rates provided unacceptable scour would not result.

8.8 The NPPF advise that Major developments 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;
d) where possible, provide multifunctional benefits.

8.9 The proforma is required to accompany a drainage strategy prepared for a planning application where required by national or local planning policy. It is to be used to summarise the key outputs from the strategy to allow assessing officers at the LLFA to quickly assess compliance with the above SuDS planning policies. A completed proforma is included in *Appendix E*, while further supporting information in connection with the surface water drainage strategy is provided under the following headings.

<u>Proposed discharge arrangement</u>

8.10 The proforma sets out a hierarchy for the discharge of surface water runoff. The methods of discharge are summarised in *Table 1* below with an assessment of each methods suitability.

Table 1: Surface Water Runoff Discharge Method

System	Assessment
Store rainwater for later use	Rainwater harvesting is the collection of rainwater runoff for use. Runoff can be collected from roofs and then used in place of mains water for certain applications. It is likely that rainwater butts could be used to collect roof water for the purposes of irrigating domestic gardens. More complex systems are also available to reduce mains water consumption in the form of harvesting systems that can store rainwater for re-use for toilet flushing. However, the proposed building footprints will occupy most of the site leaving limited space for above and below ground rainwater harvesting. Therefore, rainwater harvesting has not been considered as part of the surface water drainage strategy for the development.
Use infiltration techniques, such as porous surfaces in non-clay areas	In Section 2 it was identified that the bedrock geology of the local area is shown to be the London Clay Formation, which comprises of Clays and Silts that would be expected to be relatively impermeable in nature. In addition, in Section 4 it was identified that the site is shown to be located in an area where there is potential for groundwater flooding to occur at the surface. Therefore, infiltration techniques, such as porous surfaces in non-clay areas are not assessed to be appropriate.
Attenuation of rainwater in ponds and open water features	The development falls in a town centre environment and areas of soft landscaping are limited to private gardens with no space available for ponds and open water features.
Attenuation of rainwater through tanks or sealed water features	An area of shared parking is proposed as part of the development and a below ground storage tank could be considered beneath this area.
Discharge rainwater direct to a watercourse	The nearest watercourse is located over 250m to the west of the site. Given the substantial distance, it would not be a viable destination for surface water runoff.
Discharge rainwater to a surface water sewer/drain	A surface water sewer is network is present in the roads adjacent the site. Thames Water have advised that it would be acceptable to discharge surface water runoff from the development to the network if flows are restricted to a maximum discharge rate of 2.0 l/s and if other methods of disposal in the surface water drainage hierarchy have been investigated and proven to not be viable. Correspondence received from Thames Water is included in *Appendix D*.

Discharge rainwater to the combined sewer.	As it has been established that discharge from the development could be made to a surface water sewer, it is not appropriate to consider discharge to a combined sewer.

8.11 Based on the assessment in *Table 1*, it is assessed to be appropriate to discharge surface water runoff from the development to the surface water sewer network, if flows are restricted to a maximum discharge rate of 2.0 l/s.

Runoff Management

8.12 The proforma requires an assessment of greenfield and existing discharge rates. Greenfield runoff rates for the required storm events have been estimated based on the IH 124 Facility of the MicroDrainage Software Package. The calculation results are included in *Appendix F* and are based on the sites area of 0.06 Ha. The calculated rates for a variety of storm events up to the 1 in 100-year return period are summarised in *Table 2* below.

Table 2: Runoff Rates

Return Period (Year)	Greenfield Runoff Rate (l/s)	Existing Discharge Rate (l/s)
QBAR	0.9	N/A
1	0.7	2.3
30	1.5	5.1
100	1.7	6.6

8.13 Discharge rates for the existing brownfield site are also shown in *Table 2*, which have been established using the Modified Rational Method Formula based on 360-minute rainfall profiles. The Modified Rational Method calculations and rainfall profiles are included in *Appendix F*. The calculation results are also based on the sites area of 0.06 Ha.

8.14 Policy LP 21 requires a reduction in surface water discharge to greenfield run-off rates wherever feasible. Therefore, it is proposed to limit the rate of discharge from the development to a maximum allowable discharge rate of 1.7 l/s. This would be less than the discharge limit of 2.0 l/s recommended by Thames Water so would also comply with their requirements.

8.15 Surface water runoff exceeding the proposed discharge limit of 1.7 l/s would need to be stored and attenuated on site for all rainfall events up to and including a 1 in 100 year event with a 40% allowance for potential future increases in rainfall intensities associated with climate change. The MicroDrainage quick storage estimate tool has been used to estimate the required storage volume with the results shown in *Figure 17* below. The results are based on a drained area of 273m^2, which includes for the developments roof area, parking area and a 10% allowance for creep.

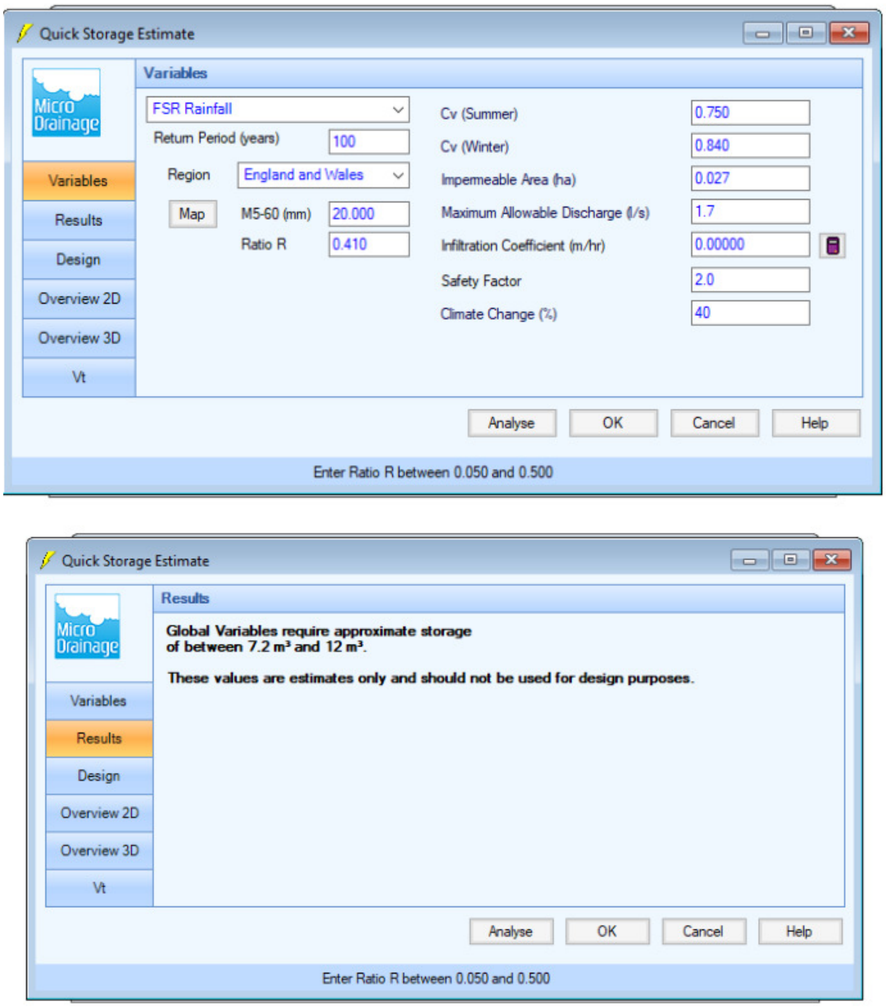


Figure 17: MicroDrainage Quick Storage Estimate

8.16 *Figure 17* shows that an estimated storage volume of between 7.2m^3 to 12.0m^3 would be required to store surface water runoff on site for a 1 in 100 year event with a 40% allowance for climate change.

Sustainable Drainage Systems (SuDS)

8.17 The London Borough of Richmond upon Thames surface water drainage policy recommends that the development should aim to restrict surface water flows from the site to greenfield runoff rates using SuDS to control surface water as close to the source as possible. *Table 3* below lists a range of SuDS techniques that can be used to minimise the rate of discharge, volume and environmental impact of runoff and provides an assessment of each methods suitability.

Table 3: SUDS Assessment

System	Assessment
Rainwater Harvesting / Attenuation Tanks	Rainwater harvesting is the collection of rainwater runoff for use. Runoff can be collected from roofs and then used in place of mains water for certain applications. It is likely that rainwater butts could be used to collect roof water for the purposes of irrigating domestic gardens. More complex systems are also available to reduce mains water consumption in the form of harvesting systems that can store rainwater for re-use for toilet flushing.

	However, the proposed building footprints will occupy most of the site leaving limited space for above and below ground rainwater harvesting. Therefore, rainwater harvesting has not been considered as part of the surface water drainage strategy for the developments.
Infiltration Systems	In Section 2 it was identified that the bedrock geology of the local area is shown to be the London Clay Formation, which comprises of Clays and Silts that would be expected to be relatively impermeable in nature. In addition, in Section 4 it was identified that the site is shown to be located in an area where there is potential for groundwater flooding to occur at the surface. Therefore, infiltration systems are not assessed to be appropriate.
Blue / Green Roofs	The proposed buildings roof structure will comprise of pitched roof profiles, which would not be suitable for blue / green roof systems.
Swales / Basins / Ponds / Wetlands	The development falls in a town centre environment and areas of soft landscaping are limited to private gardens with no space available for swales, basins, ponds, or wetlands.
Bioretention / tree pits	The development falls in a town centre environment and areas of soft landscaping are limited to private gardens with no space available for bioretention or tree pits.
Filter Strips / Filter Drains / Pervious Pavements	Although infiltration systems are not considered to be appropriate for the site, pervious pavements and filter drains could be used to intercept / retain / treat precipitation as well as reduce runoff rates from paved surfaces provided that they are connected to a surface water drainage network.
Attenuation Tanks	An area of shared parking is proposed as part of the development and a below ground storage tank could be considered beneath this area for the attenuation of surface water and for gradual release.

Drainage Strategy

8.18 Based on the assessment in *Table 3*, a surface water drainage scheme has been developed for the site and is shown on the proposed drainage strategy plan included in *Appendix G*. A description of the proposals is provided below.

– Roof water runoff from dwellings would be captured by a combination of rainwater gutters, downpipes that would discharge to rainwater butts where feasible for the purposes of irrigating domestic gardens.

– The parking spaces are shown to be constructed using a pervious pavement system, which would allow surface water runoff to filter into a 525mm thick layer of porous sub-base, providing 9.2m^3 of storage volume for the attenuation of surface water runoff.

– The pervious pavement system would be lined with an impermeable geomembrane to prevent groundwater from entering the system.

– The roof drainage systems would connect to a traditional network of below ground pipework, which would discharge to the zone of porous sub-base located beneath the shared parking spaces.

– The outfall from the system would be restricted to a maximum allowable discharge rate of 1.7 l/s using a flow control chamber before discharging the surface water sewer network and the below ground geocellular storage tank and pervious pavement system would store excess runoff for all storm return periods up to and including a 1 in 100 year event with 40% allowance for climate change.

8.19 Design results for the system are included in *Appendix H*. A summary of the design results is provided in *Table 4* below.

Table 4: System Design Results

Catchment Area (m^2)	Max. Storage Volume (m^3)	Discharge Rate (l/s)			
		1 in 1	1 in 30	1 in 100	1 in 100 + 40%
272	9.2	0.7	1.2	1.4	1.7

8.20 The design results show that the system would store surface water up to and including a 1 in 100-year rainfall event with 40% allowance for climate change.

8.21 *Table 5* below compares the combined maximum rate of discharge analysed for each storm event to the greenfield / brownfield runoff rates identified in *Table 4*.

Table 5: Comparison of Discharge Rates

Return Period	Greenfield	Brownfield	
		Pre-Development	Post-Development
	Peak Runoff Rate (l/s)	6hr Runoff Rate (l/s)	Peak Runoff Rate (l/s)
1	0.7	2.3	0.7
30	1.5	5.1	1.2
100	1.7	6.6	1.4
100+40	1.7	6.6	1.7

8.22 The above table shows that surface water flows from the development would be less than or equal to the greenfield runoff rate for all analysed rainfall events up to and including the 1 in 100 year return period with 40% allowance for climate change. This would be in accordance with the London Borough of Richmond upon Thames surface water drainage policy and advice received from Thames Water, with flows not exceeding their recommended restricted rate of discharge of 2.0 l/s.

Exceedance

8.23 Overland surface water flows resulting from exceedance of the drainage systems capacity or resulting from a blockage should be managed in a manner that minimises the risks to people and property.

8.24 If the capacity of these systems was exceeded, the buildings would still be protected from surface water flooding as the ground levels of buildings would be raised above surrounding road and landscaping levels.

Water Quality

8.25 The proposed SuDS systems would fulfil the water quality aims of the London Borough of Richmond upon Thame surface water drainage policy. The CIRIA C753 SuDS Manual 2015 sets out requirements for delivering appropriate levels of treatment to surface water runoff using SuDS. *Table 6* below identifies that the proposed SuDS components would have a total pollution mitigation index equal to or exceeding the recommended pollution hazard index thus confirming the SuDS components would provide suitable treatment to surface water runoff.

Table 6: Comparison of Discharge Rates & Volumes

Use	Pollution Hazard Index			SUDS Component	Mitigation Index		
	TSS	Metals	TPH		TSS	Metals	TPH
Roof	0.3	0.2	0.05	Porous Sub-base	0.4	0.4	0.4
Roads / Parking	0.5	0.4	0.4	Pervious Pavement	0.7	0.6	0.7

Amenity / Biodiversity

8.26 The new gardens proposed for the development would maximise amenity and biodiversity benefits, over the existing situation.

Maintenance

8.27 Property owners would be responsible for the maintenance of the drainage systems within their individual properties, while shared drainage systems forming part of the estate would be maintained as part of wider communal infrastructure by a management company. On occupation of the development, a maintenance and management plan would be incorporated into each developments Operation and Maintenance Manual with the as-built drainage system operated and maintained in accordance with the regime set out in the plan.

9. CONCLUSIONS

9.1 It has been established that the site is located in Flood Zone 2, which is an area assessed to be at medium probability of flooding from the River Crane. The residual risk of flooding to the site can be effectively managed by setting the proposed buildings ground floor levels above the predicted flood level of 6.34mAOD for the 0.1% AEP.

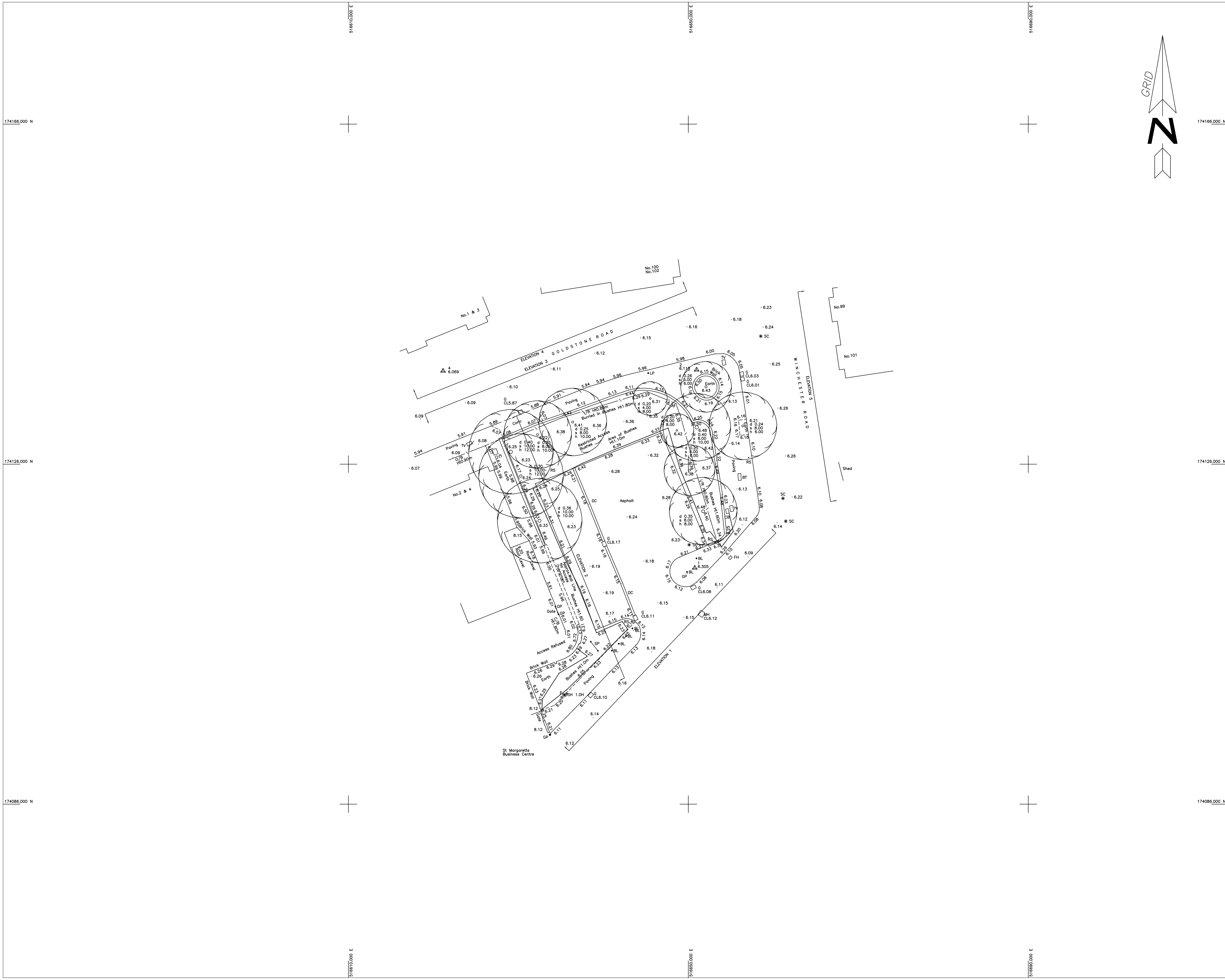
9.2 National and Local Policy aims to avoid inappropriate development in areas at risk of flooding and recommends that development is directed towards areas at lowest flood risk. The NPPF and Local Policy of the London Borough of Richmond upon Thames advises that residential developments are a more vulnerable use and appropriate in Flood Zone 2 provided they pass the sequential test with it not being necessary to apply the exception test.

9.3 Raising the proposed buildings floor level would largely address the risk of flooding from other sources. However, National and Local Policy requires development to seek opportunities to reduce the overall level of flood risk in the area and beyond through the use of Sustainable Drainage Systems (SuDS). A hierarchical assessment has established that an existing surface water sewer in the roads adjacent the site would be the most appropriate destination for the disposal of surface water runoff from the development provided that surface water flows are limited to a maximum allowable discharge rate of 1.7 l/s using SuDS.

9.4 A further hierarchical assessment has established that water butts and pervious pavement system would be the most appropriate SuDS components for minimising the rate of discharge, volume and environmental impact of surface water runoff from the development. A surface water drainage strategy has been developed for the site comprising of these components, which would ensure that surface water flows are controlled as close to the source as possible, prior to discharging to the surface water sewer, with flows restricted to a maximum allowable discharge rate of 1.7 l/s for all analysed rainfall events up to and including the 1 in 100 year return period with 40% allowance for climate change. The systems would also provide sufficient capacity for excess runoff to be stored and attenuated on site for all rainfall events up to and including the 1 in 100-year storm return period with 40% allowance for climate change.

9.5 In terms of flood risk, it is concluded that the development can be occupied and operated safely and that there will be no increase in the level of flood risk to the site or neighbouring sites because of the development.

APPENDIX A
TOPOGRAPHICAL SURVEY



LASER SURVEYS

LAND AND BUILDING SURVEYS, UNDERGROUND SERVICES LOCATION, CCTV DRAINAGE SURVEYS.

Established 1975. Member of The Survey Association.

OPEN SPACE,UPPER INTERFIELDS,LEIGH SINTON ROAD,MALVERN,WORCESTERSHIRE WR14 1UT
TEL 01886 833173 email: worcester@lasersurveys.com

THE OLD DAIRY,STUBBERS FARM,MOUNTNESSING ROAD,BLACKMORE,ESSEX CM4 0NX
TEL 01277 821555. email: london@lasersurveys.com

DATUM NOTES

GRID IS BASED UPON SURVEY CONTROL STATION No.1, FIXED TO THE ORDNANCE SURVEY NATIONAL GRID BY GPS SATELLITE ACTIVE NETWORK.

LEVELS ARE RELATED TO :- THE ORDNANCE SURVEY GPS ACTIVE NETWORK AND TRANSFORMED USING THE OSGM15 & OSTN15 MODELS.

BENCH MARK USED IS LOCATED AT :- SURVEY CONTROL STATION No.1

VALUE GIVEN AS 6.305m (NEWLYN DATUM)

SURVEY CONTROL STATIONS SHOWN △

ABBREVIATIONS (where applicable)

AV	Air Valve	MH	Manhole Cover
BK	Brick	MK	Marker
BL	Bollard	MS	Milestone
BS	Bus Stop	MT	Meter
BT	British Telecom	MY	Mercury
C/B	Close Boarded	O/B	Open Boarded
CL	Cover Level	OH	Overhead
CLK	Chainlink	PAV	Paving
CO	Column	PB	Pedestrian Push Button
Conc	Concrete	PE	Pipe
CP	Catch Pit	PM	Parking Meter
CPS	Concrete Paving Slabs	P/R	Post and Rail
CTV	Cable Television	PT	Post
DC	Drainage Channel	P/W	Post and Wire
DP	Drain Pipe	RE	Rodding Eye
EP	Electricity Pole	RET	Retaining
ER	Earthing Rod	RS	Road Sign
FB	Flower Bed	RSJ	Rolled Steel Joist
FE	Fence	SC	Stop Cock
FH	Fire Hydrant	SK	Soakaway
FL	Floor Level	SPT	Septic Tank
FP	Flag Pole	ST	Silt Trap
GP	Gate Post	SV	Stop Valve
GV	Gas Valve	SVC	Security Video Camera
GY,G	Gully	TCB	Telephone Call Box
HT	Height	TL	Traffic Light
IC	Inspection Cover	TK	Tank
IL	Invert Level	TP	Telegraph Pole
IN	Interceptor	UG	Underground
I/R	Iron Railings	UTF	Unable To Trace Further
JB	Junction Box	UTL	Unable To Lift
KO	Kerb Outlet	VP	Vent Pipe
LB	Litter Bin	WL	Water Level
LP	Lamp Post	WM	Water Meter
		WO	Wash Out

NOTES

* Drainage pipe sizes (where shown) have been gauged from the surface for safety reasons and should be regarded as approximate only.
* Tree species (where shown) should be treated with caution and expert identification is advised.
* Although this is a digital survey the accuracy and amount of detail shown is only commensurate with the graphical scale of mapping as specified. Care should be exercised when working to larger scales.
* Visible features in the vicinity of the boundaries as shown above, may not represent the extent of legally conveyed ownership.
* Whilst every effort has been made to achieve accuracy on this plan, CRUCIAL clearance dimensions, levels and invert levels should be checked prior to design and construction.
* Kerb levels have been taken in the bottom of the channel.
* Areas of dense undergrowth cannot be surveyed in detail, these areas will be shown in outline only and marked as "dense undergrowth" on the plan

SHEET LAYOUT

LAND AT ST MARGARET'S WORKS
TWICKENHAM
LONDON
TW1 1JN

TOPOGRAPHICAL SURVEY

SURVEYED FOR GODSTONE DEVELOPMENTS LTD
107 BELL STREET
LONDON
NW1 6TL

SURVEYOR JC
DATE JUNE 2020

NO	DATE	REVISION

DRAWING NO	L 9826/1	REV
SCALE	1 : 200 @ A1	
SEE ALSO DWG NOS	L .	
SHEET	1 of 2	
REF NO	L 9826	

APPENDIX B
PLANNING DRAWINGS

Revision	Date	Description

Do not scale-off this drawing. Wimshurst Pelleriti take no responsibility for any dimensions obtained by measuring or scaling from this drawing and no reliance may be placed on such dimensions. If no dimension is given, it is the responsibility of the recipient to ascertain the dimension specifically from the Architect or by site measurement.

The sizing of all structural and service elements must always be checked against the relevant engineers drawings. No reliance should be placed upon sizing information shown on this drawing.

Project
St Margarets Business Centre
Richmond, London

Drawing Title
GA Plan
Proposed Level GF
External Layout Option 1

Drawing Number
WP-0780-A-0100-P-00

Revision

Scale @ A1
1:100

Revision Date

Drawing Purpose
DRAFT FOR DISCUSSION

WIMSHURST PELLERITI

The Mews,
6 Putney Common, SW15 1HL

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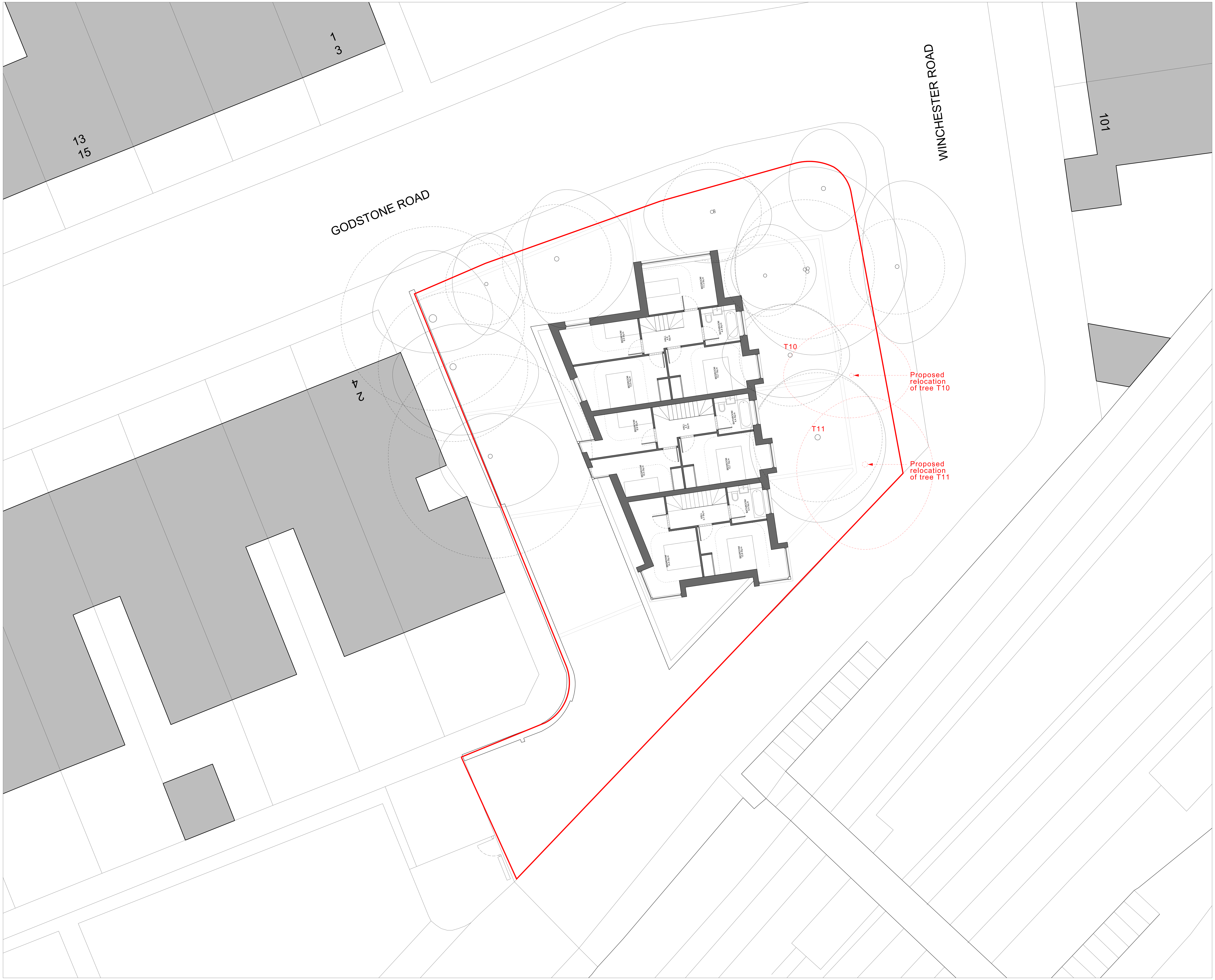

Revision | Date | Description

Project
St Margarets Business Centre
Richmond, London

Drawing Title
GA Plan
Proposed Level First Floor

Drawing Number
WP-0780-A-0101-P-01

Revision

Scale @ A1
1:100

Revision Date

Drawing Purpose
DRAFT FOR DISCUSSION

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Project
St Margarets Business Centre
Richmond, London

Drawing Title
GA Plan
Proposed Level Second Floor

Drawing Number
WP-0780-A-0102-P-02

Revision

Scale @ A1
1:100

Revision Date

Drawing Purpose
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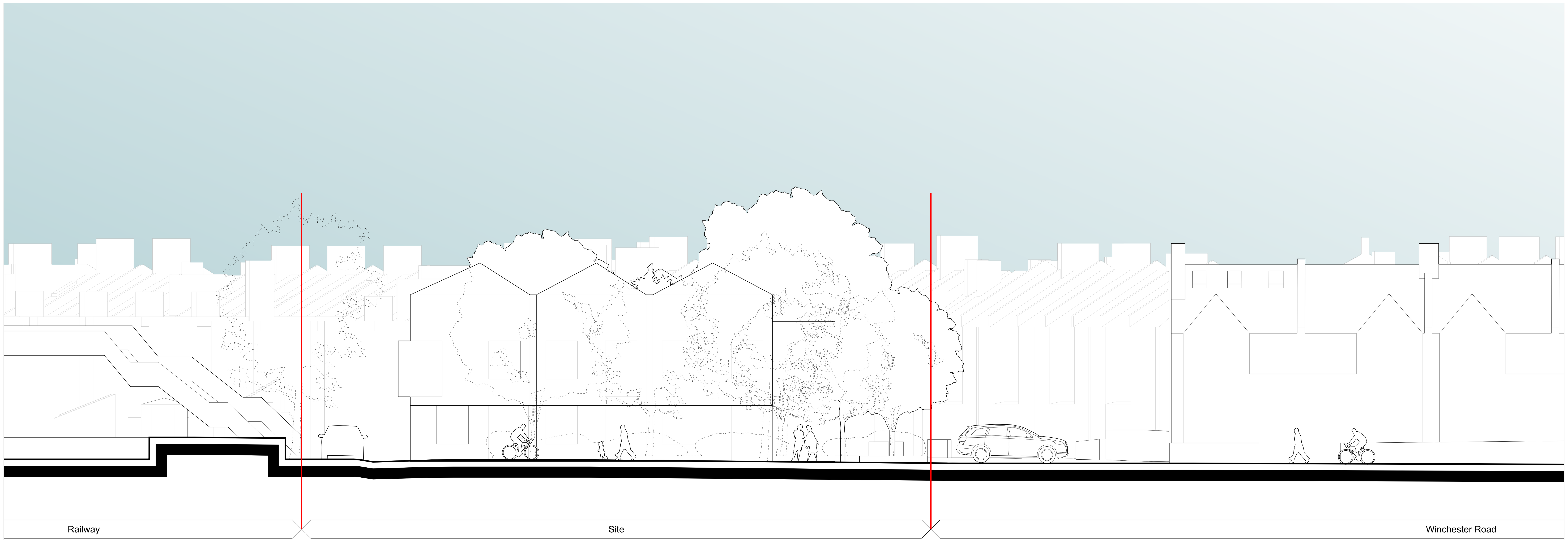
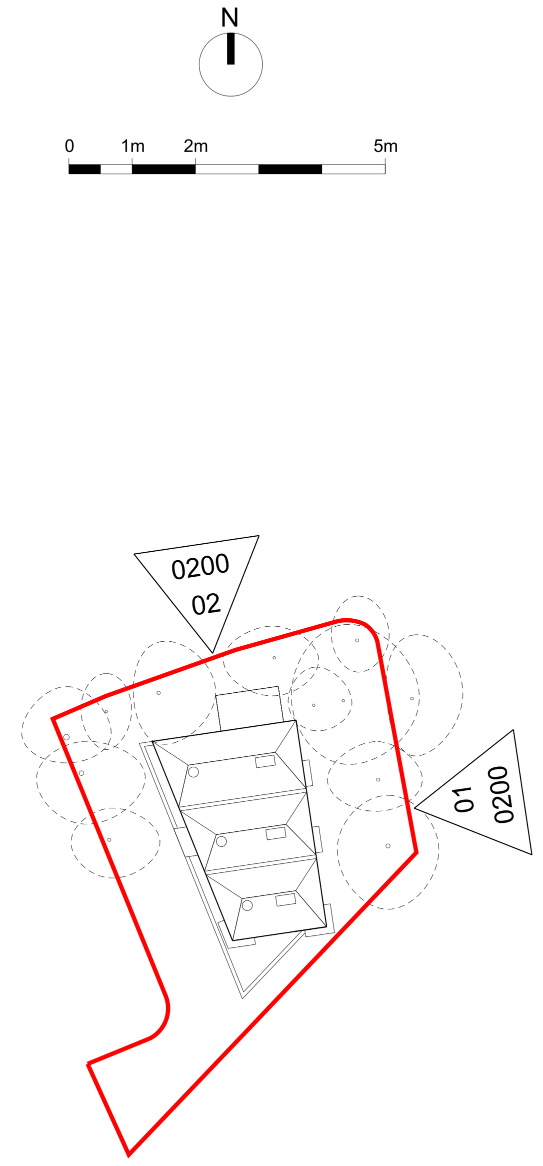


01
0200
East Elevation

02
0200
North Elevation



-

Revision	Date	Description

Project
St Margarets Business Centre
Richmond, London

Drawing Title
Proposed Elevations
East & North

Drawing Number WP-0780-A-0200-E-XX
Revision

Scale @ A1 1:100
Revision Date

Drawing Purpose
DRAFT FOR DISCUSSION

WIMSHURST PELLERITI

The Mews,
6 Putney Common, SW15 1HL

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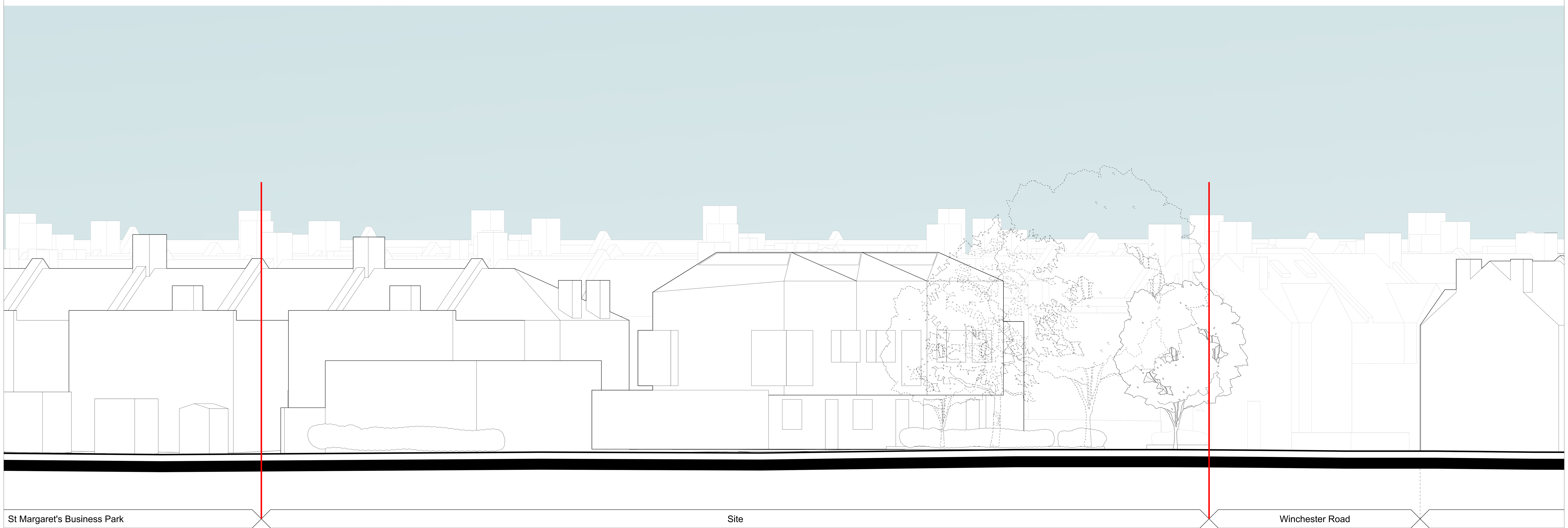
01
0201

West Elevation



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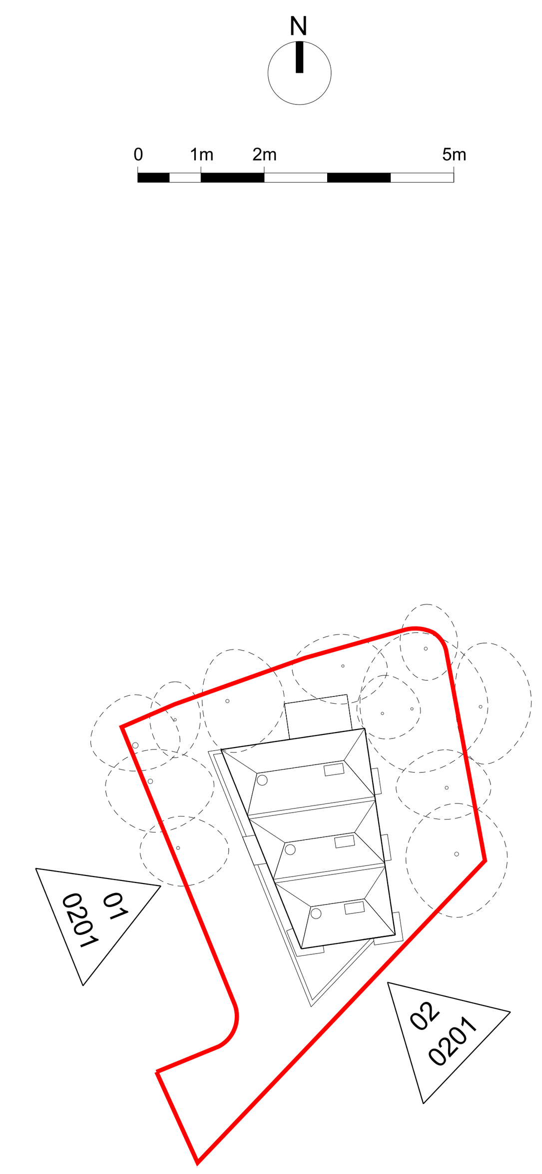
South Elevation



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Revision	Date	Description

Project
St Margarets Business Centre
Richmond, London

Drawing Title
Proposed Elevations
West & South

Drawing Number
WP-0780-A-0201-E-XX

Revision

Scale @ A1
1:100

Revision Date

Drawing Purpose
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The Mews,
6 Putney Common, SW15 1HL

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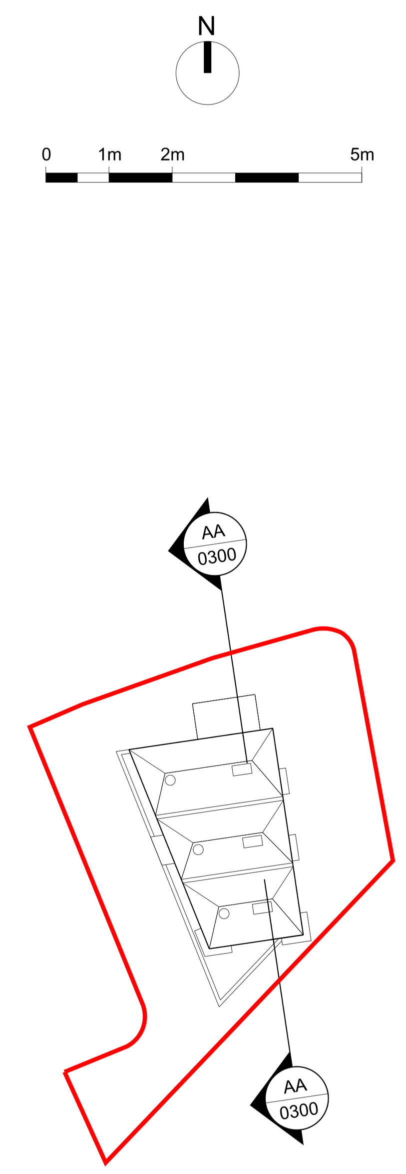

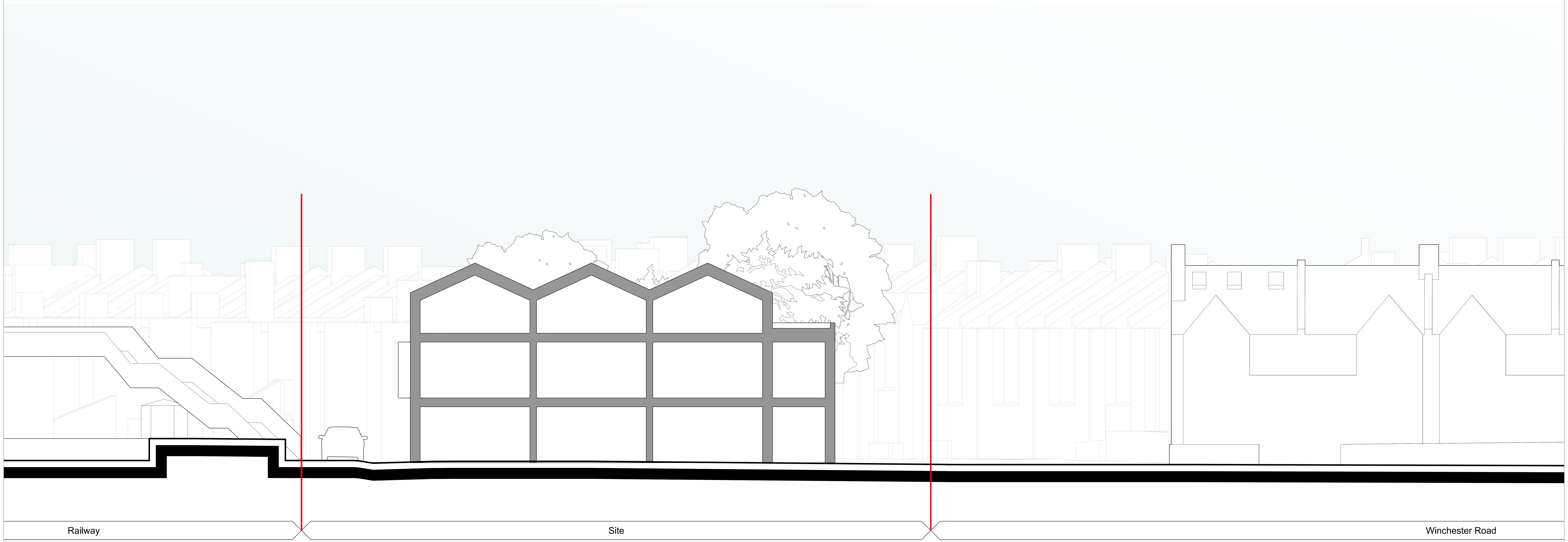

AA
0300

Section AA

-

Revision	Date	Description

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Project
St Margarets Business Centre
Richmond, London

Drawing Title
Proposed Sections
AA

Drawing Number WP-0780-A-0300-S-XX
Revision

Scale @ A1 1:100
Revision Date

Drawing Purpose
DRAFT FOR DISCUSSION

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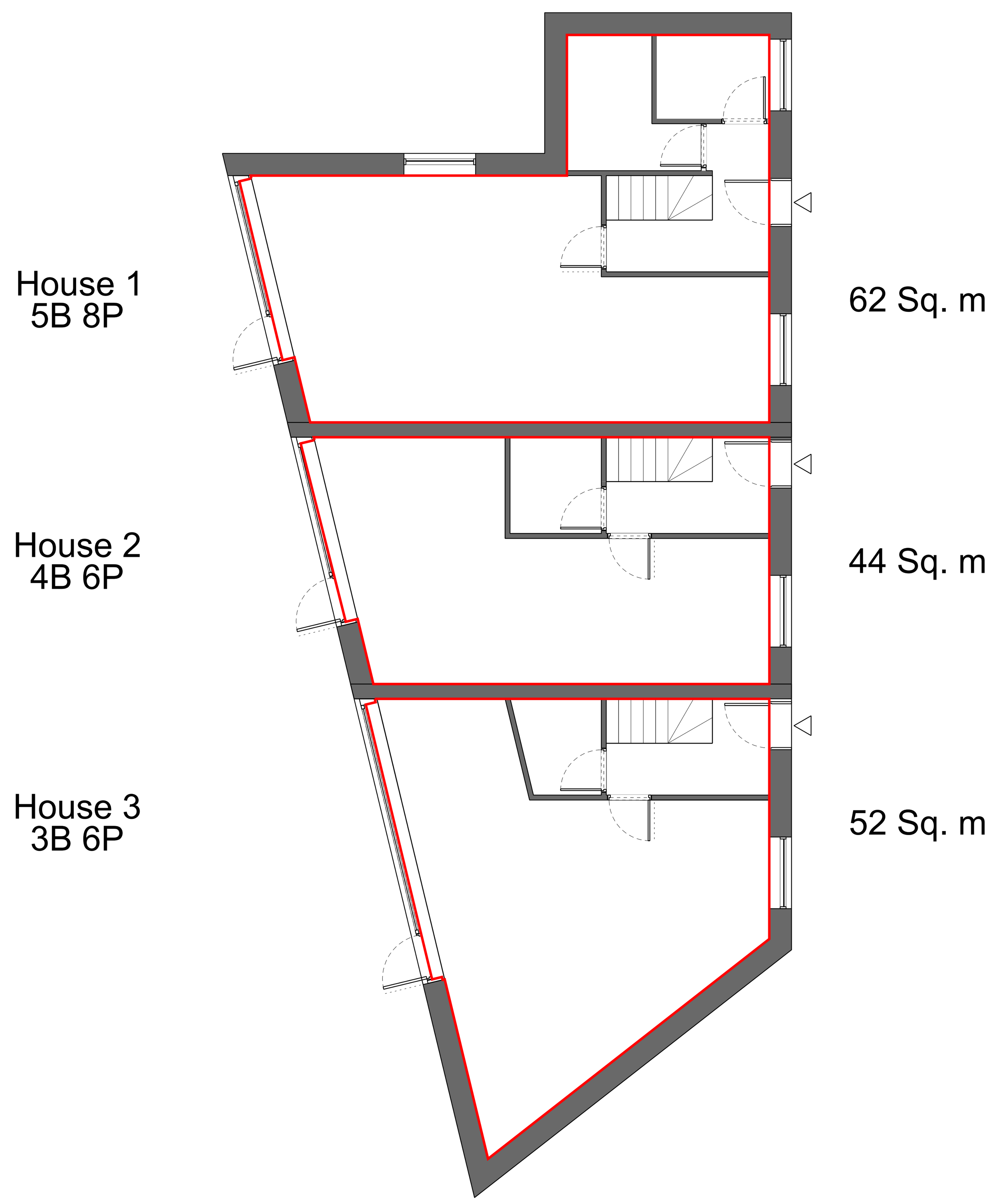
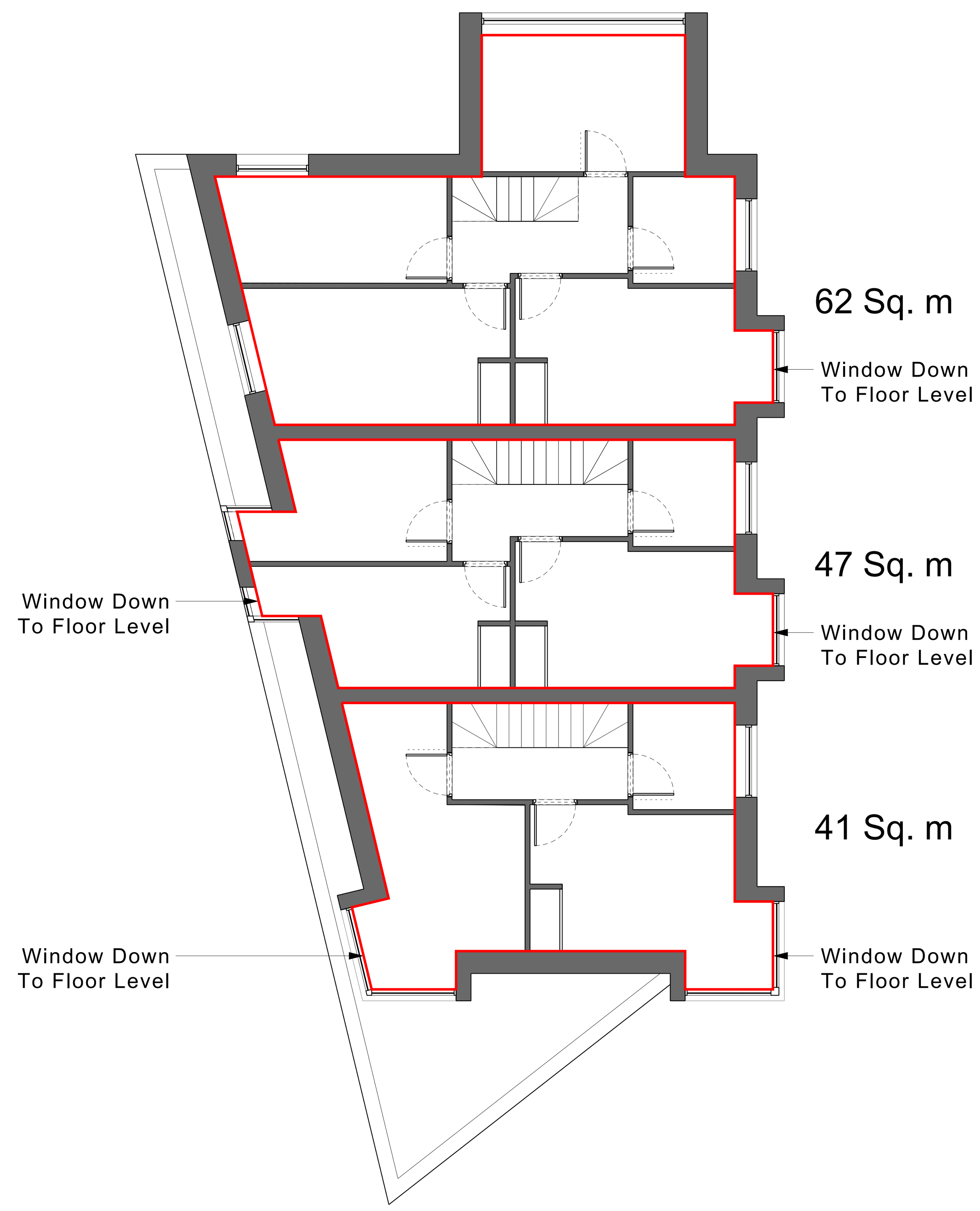
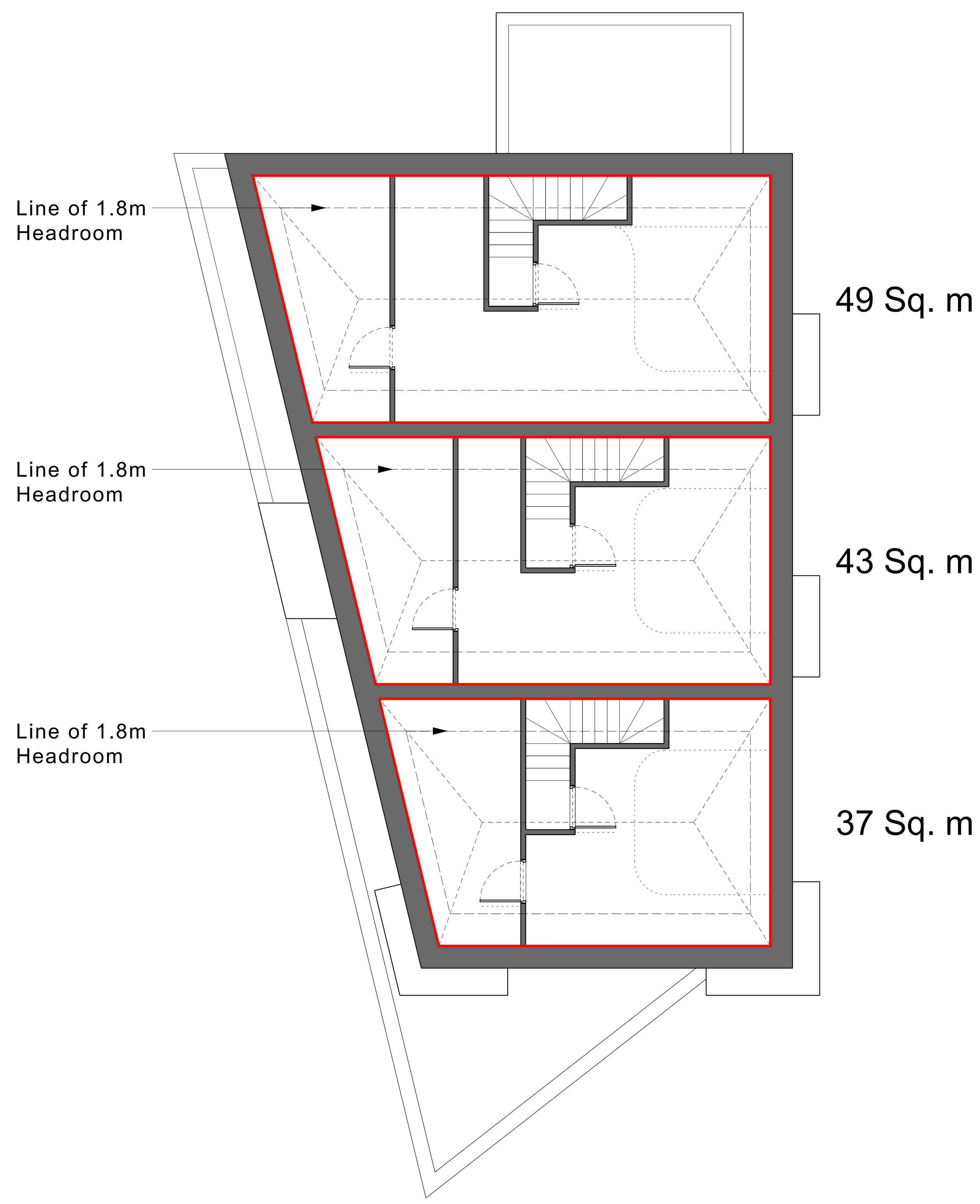


01 0400 Ground Floor Areas

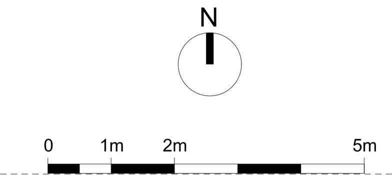


02 0400 First Floor Areas



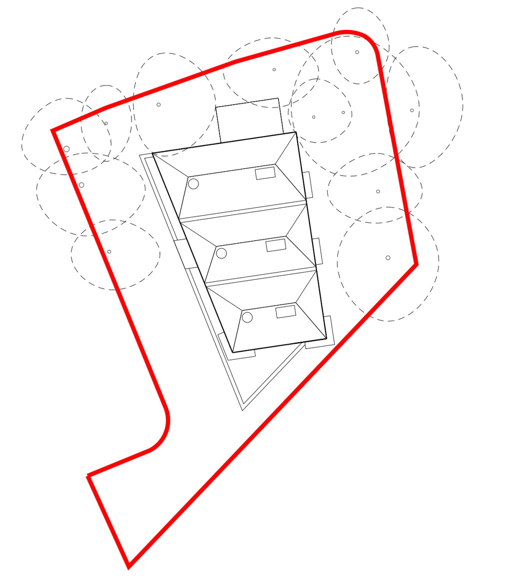
03 0400 Second Floor Areas

Areas in Sqm	House 1 5B 8P	House 2 4B 6P	House 3 3B 6P
Ground	62	44	52
1st	62	47	41
2nd	49	43	37
Total	**173**	**134**	**130**
Minimum Required To Meet NDSS	134	112	108



AREA CALCULATIONS

These areas have been measured from plans produced at tage 2 pre-planning and are approximate and illustrative only. Further development of the design, measurement and construction tolerances and/or further client/tenant requests will inevitably result in changes to these areas [which could involve significant reductions] and WP accept no legal responsibility for any decision, commercial or otherwise, made on the basis of these areas.



Revision	Date	Description

Project
St Margarets Business Centre
Richmond, London

Drawing Title
Area Schedule

Drawing Number WP-0780-A-0400-P-XX
Revision

Scale @ A1 1:100
Revision Date

Drawing Purpose
DRAFT FOR DISCUSSION

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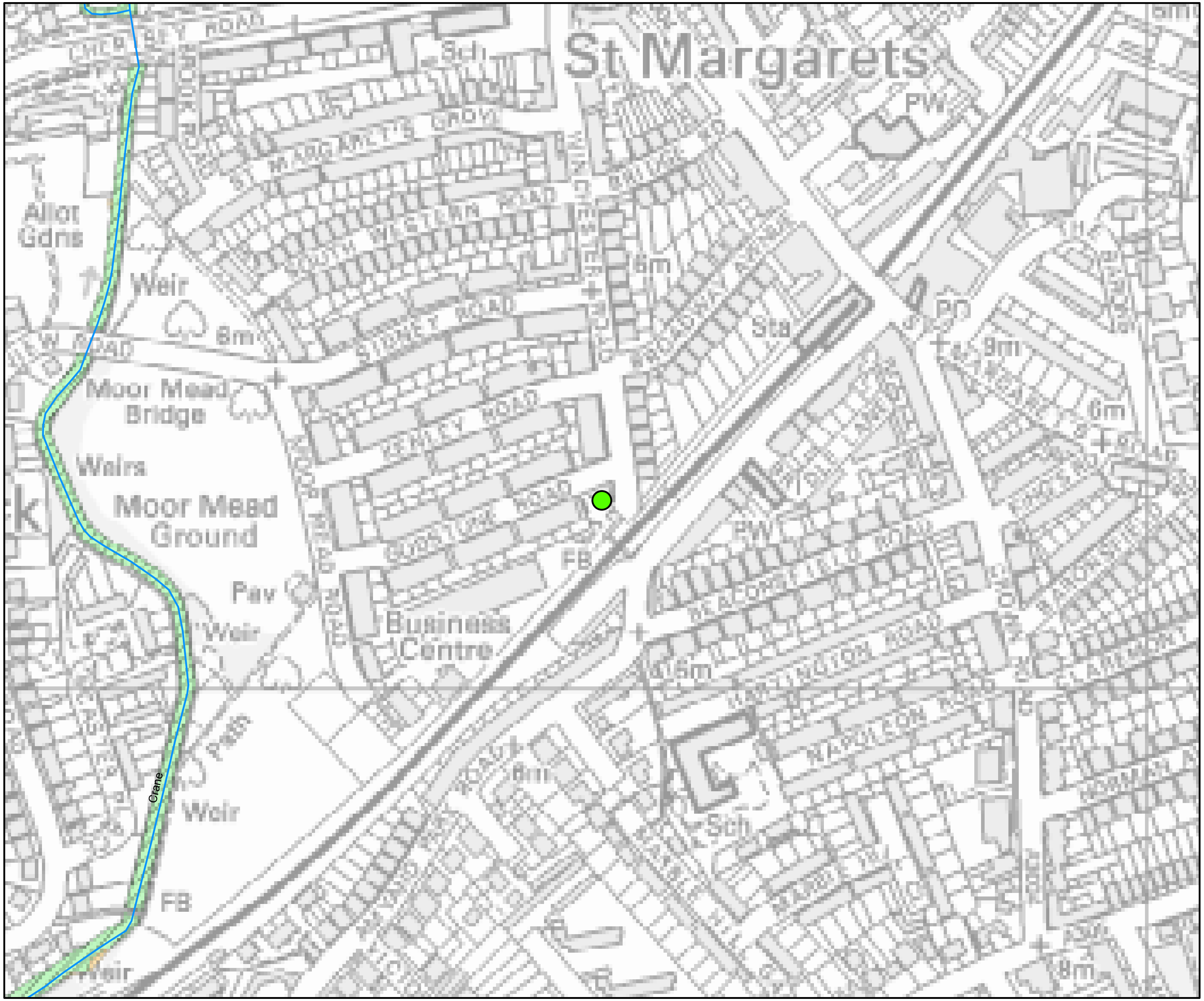
APPENDIX C
EA FLOOD RISK DATA

Detailed FRA centred on: St Margarets Business Park Car Park, Twickenham, TW1 1JS - 03/03/2022 - HNL 253000 NR



Environment Agency
Alchemy,
Bessemer Road,
Welwyn Garden City,
Hertfordshire,
AL7 1HE

N

0 50 100 200
Metres

Legend

Main Rivers

Site location

Defended Flood Outlines

1 in 5 (20%) Defended

1 in 10 (10%) Defended

1 in 20 (5%) Defended

1 in 50 (2%) Defended

The data in this map has been extracted from the River Crane Mapping Study (Halcrow 2008).
This model has been designed for catchment wide flood risk mapping. It should be noted that it was not created to produce flood levels for specific development sites withinthe catchment.
Modelled outlines take into account catchment wide defences.

Flood risk data requests including an allowance for climate change will be based on the 1 in 100 flood plus 20% allowance for climate change, unless otherwise stated. You should refer to 'Flood risk assessments: climate change allowances' to check if this allowance is still appropriate for the type of development you are proposing and its location. You may need to undertake further assessment of future flood risk using different allowances to ensure your assessment of future flood risk is based on best available evidence.
https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

Produced by:
Partnerships & Strategic Overview,
Hertfordshire & North London

Detailed FRA centred on: St Margarets Business Park Car Park, Twickenham, TW1 1JS - 03/03/2022 - HNL 253000 NR

Environment Agency
Alchemy,
Bessemer Road,
Welwyn Garden City,
Hertfordshire,
AL7 1HE

N

0 50 100 200
Metres

Legend

Main Rivers

Site location

Defended Flood Outlines

1 in 100 (1%) Defended

1 in 100+20% (*CC) Defended

1 in 100+25% (*CC) Defended

1 in 100+30% (*CC) Defended

The data in this map has been extracted from the River Crane Mapping Study (Halcrow 2008).
This model has been designed for catchment wide flood risk mapping. It should be noted that it was not created to produce flood levels for specific development sites withinthe catchment.
Modelled outlines take into account catchment wide defences.
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https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

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Hertfordshire & North London

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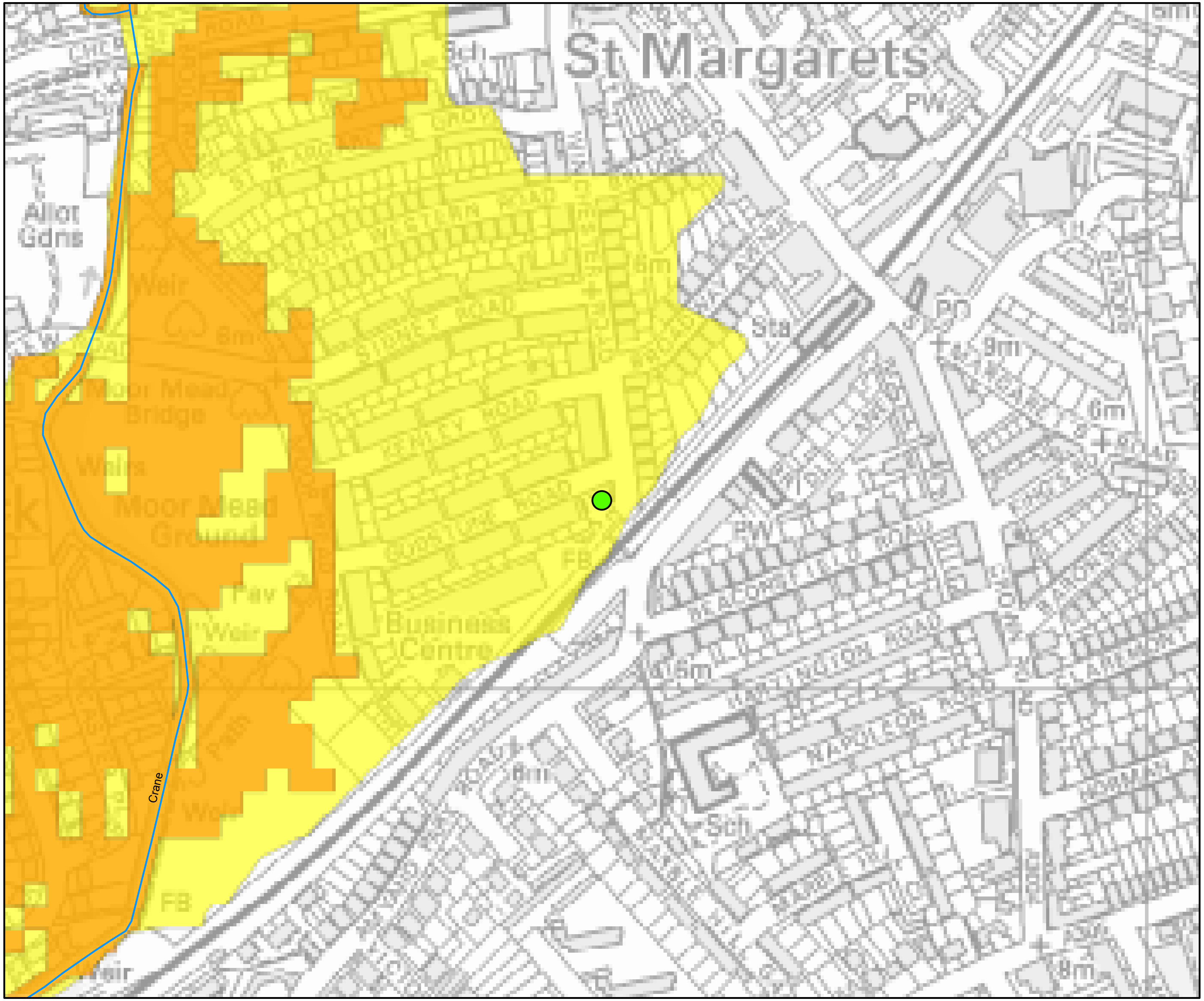


Environment Agency
Alchemy,
Bessemer Road,
Welwyn Garden City,
Hertfordshire,
AL7 1HE

N

0 50 100 200
Metres

Legend

Main Rivers

Site location

Defended Flood Outlines

1 in 100+70% (*CC) Defended

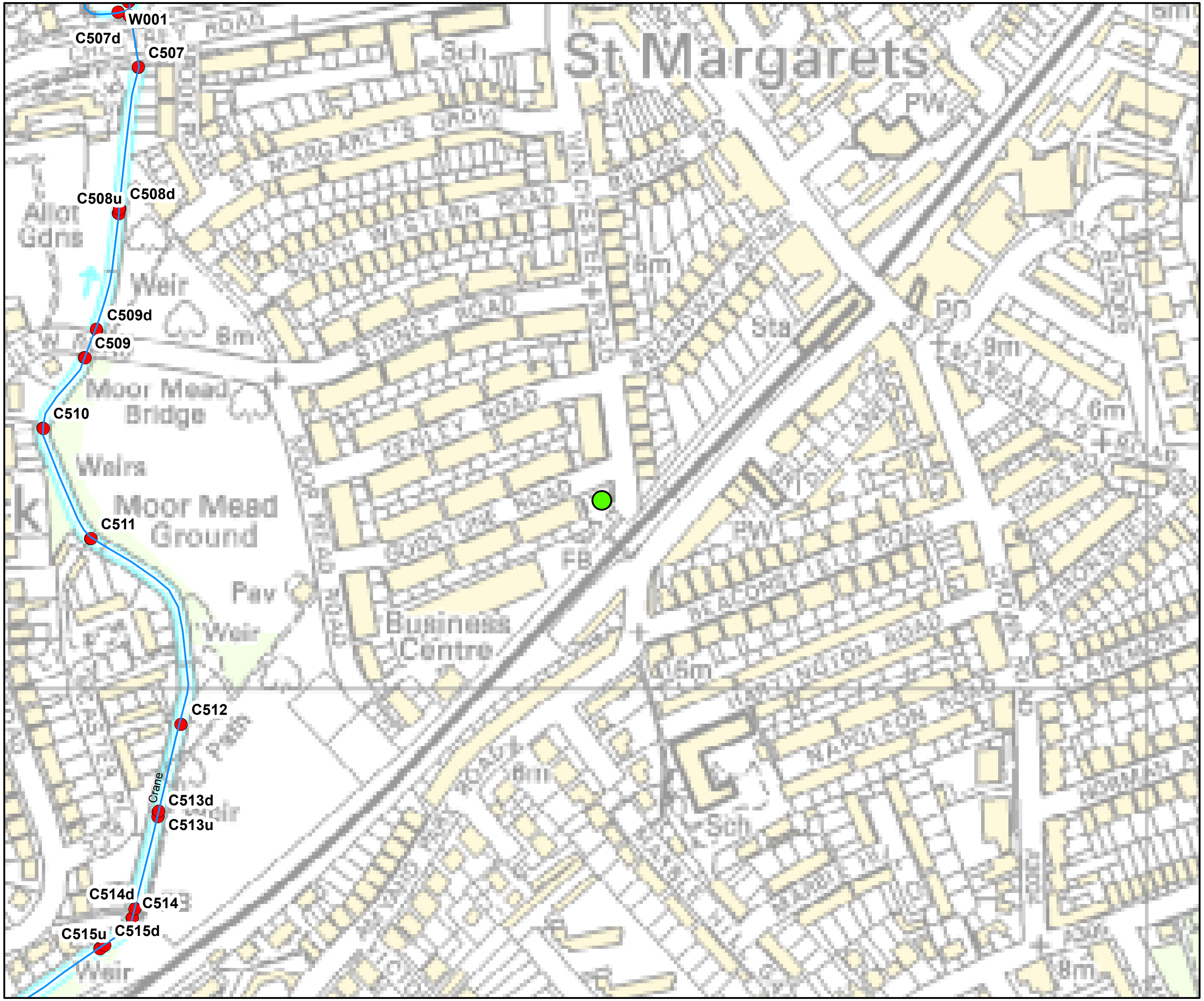
1 in 1000 (0.1%) Defended

The data in this map has been extracted from the River Crane Mapping Study (Halcrow 2008).
This model has been designed for catchment wide flood risk mapping. It should be noted that it was not created to produce flood levels for specific development sites withinthe catchment.
Modelled outlines take into account catchment wide defences.

Flood risk data requests including an allowance for climate change will be based on the 1 in 100 flood plus 20% allowance for climate change, unless otherwise stated. You should refer to 'Flood risk assessments: climate change allowances' to check if this allowance is still appropriate for the type of development you are proposing and its location. You may need to undertake further assessment of future flood risk using different allowances to ensure your assessment of future flood risk is based on best available evidence.
https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

Produced by:
Partnerships & Strategic Overview,
Hertfordshire & North London

Detailed FRA centred on: St Margarets Business Park Car Park, Twickenham, TW1 1JS - 03/03/2022 - HNL 253000 NR



Environment Agency
Alchemy,
Bessemer Road,
Welwyn Garden City,
Hertfordshire,
AL7 1HE

N

0 50 100 200

Metres

Legend

Main Rivers

Site location

1D Node Results

Node Results

The data in this map has been extracted from the River Crane Mapping Study (Halcrow 2008).
This model has been designed for catchment wide flood risk mapping. It should be noted that it was not created to produce flood levels for specific development sites withinthe catchment.
Modelled outlines take into account catchment wide defences.

Flood risk data requests including an allowance for climate change will be based on the 1 in 100 flood plus 20% allowance for climate change, unless otherwise stated. You should refer to 'Flood risk assessments: climate change allowances' to check if this allowance is still appropriate for the type of development you are proposing and its location. You may need to undertake further assessment of future flood risk using different allowances to ensure your assessment of future flood risk is based on best available evidence.
https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

Produced by:
Partnerships & Strategic Overview,
Hertfordshire & North London

Environment Agency ref: HNL 253000 NR

The following information has been extracted from the River Crane Mapping Study (Halcrow 2008)

Flood risk data requests including an allowance for climate change will be based on the 1 in 100 flood plus 20% allowance for climate change, unless otherwise stated. You should refer to 'Flood risk assessments: climate change allowances' to check if this allowance is still appropriate for the type of development you are proposing and its location. You may need to undertake further assessment of future flood risk using different allowances to ensure your assessment of future flood risk is based on best available evidence.

https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

Caution:

The modelled flood levels and extents are appropriate for catchment wide strategic flood risk mapping. However, for more detailed flood risk assessment it is recommended that each of the underlying flood mapping, hydraulic modelling and hydrological assumptions are re-evaluated to determine the appropriateness in a more detailed analysis.

All flood levels are given in metres Above Ordnance Datum (mAOD)
All flows are given in cubic metres per second (cumecs)

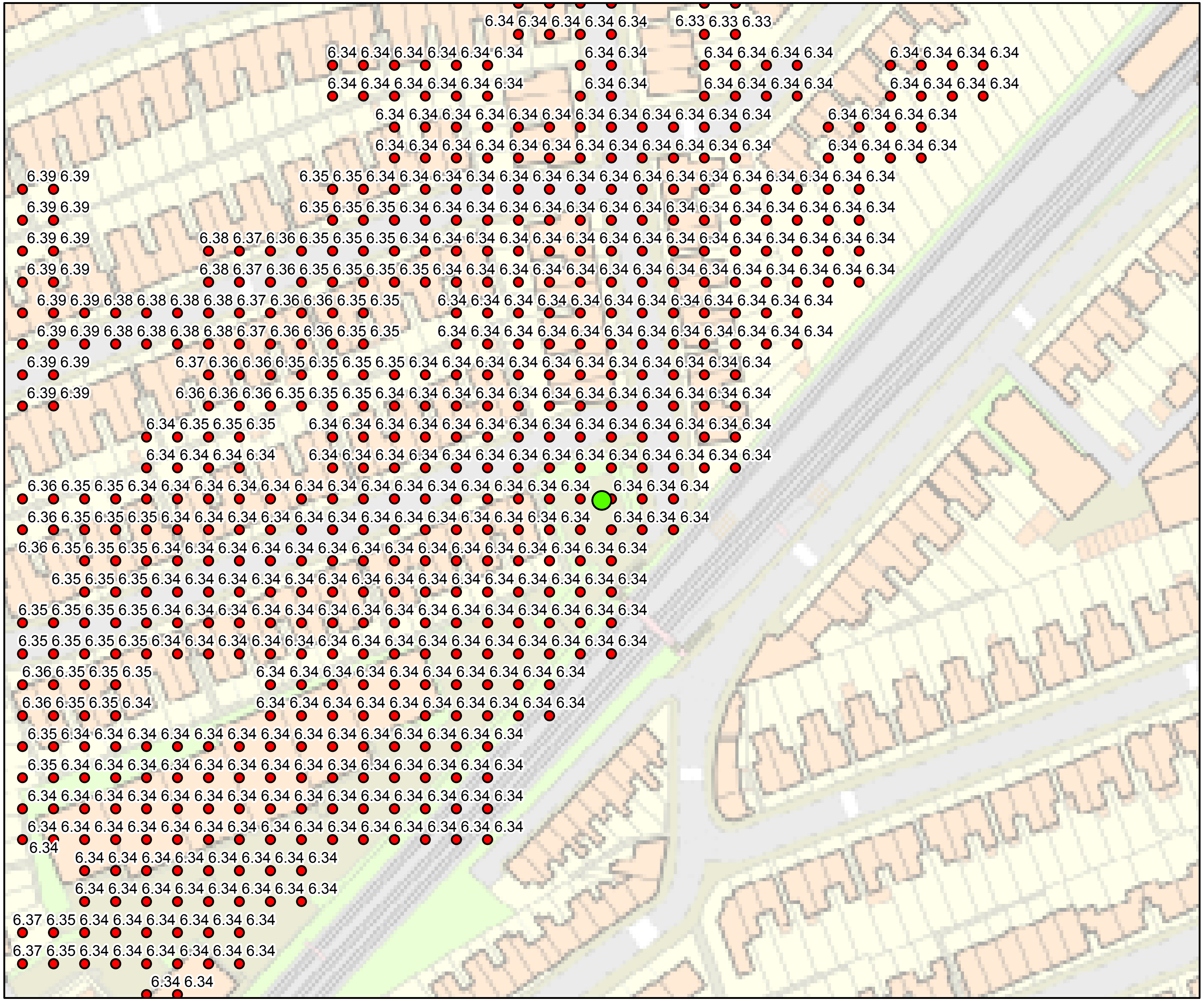
MODELLED FLOOD LEVEL

			Return Period									
Node Label	**Easting**	**Northing**	**5 yr**	**10 yr**	**20 yr**	**50 yr**	**100 yr**	**100yr + 20%**	**100yr + 25%**	**100yr + 35%**	**100yr + 70%**	**1000yr**
C515u	516321	173829	6.78	6.84	6.87	6.90	6.92	6.96	6.98	7.09	7.11	7.15
C515d	516321	173829	6.70	6.76	6.78	6.81	6.84	6.88	6.89	7.01	7.03	7.06
C514	516339	173852	6.65	6.70	6.73	6.76	6.78	6.82	6.84	6.95	6.97	7.00
C514d	516339	173852	6.65	6.71	6.74	6.77	6.80	6.85	6.86	6.98	7.00	7.04
C513u	516352	173919	6.57	6.63	6.65	6.68	6.70	6.74	6.76	6.86	6.87	6.90
C513d	516352	173919	6.47	6.52	6.54	6.57	6.59	6.63	6.65	6.74	6.76	6.77
C512	516370	173977	6.41	6.46	6.48	6.51	6.53	6.57	6.58	6.68	6.70	6.71
C511	516311	174096	6.28	6.32	6.35	6.38	6.40	6.44	6.45	6.54	6.57	6.59
C510	516281	174173	6.23	6.28	6.31	6.34	6.36	6.40	6.41	6.51	6.54	6.60
C509	516314	174220	6.21	6.26	6.29	6.31	6.34	6.37	6.39	6.48	6.50	6.54
C509d	516314	174220	6.21	6.25	6.27	6.30	6.31	6.35	6.36	6.43	6.44	6.47
C508u	516332	174310	6.11	6.15	6.17	6.19	6.21	6.24	6.25	6.32	6.33	6.36
C508d	516332	174310	5.41	5.45	5.46	5.48	5.50	5.52	5.53	5.59	5.61	5.70
C507	516338	174406	5.30	5.33	5.35	5.37	5.38	5.41	5.42	5.48	5.50	5.63
C507d	516338	174406	5.22	5.25	5.27	5.29	5.30	5.32	5.33	5.40	5.42	5.58
W001	516330	174440	5.20	5.24	5.25	5.27	5.28	5.31	5.32	5.38	5.40	5.57

MODELLED FLOWS

			Return Period									
Node Label	**Easting**	**Northing**	**5 yr**	**10 yr**	**20 yr**	**50 yr**	**100 yr**	**100yr + 20%**	**100yr + 25%**	**100yr + 35%**	**100yr + 70%**	**1000yr**
C515u	516321	173829	24.16	25.42	26.05	26.69	27.29	28.17	28.51	30.97	31.56	32.85
C515d	516321	173829	24.16	25.42	26.05	26.69	27.29	28.17	28.51	30.97	31.56	32.85
C514	516339	173852	24.16	25.42	26.05	26.69	27.29	28.17	28.51	30.97	31.56	32.93
C514d	516339	173852	24.16	25.42	26.05	26.69	27.29	28.17	28.51	30.97	31.56	32.93
C513u	516352	173919	24.16	25.42	26.05	26.69	27.29	28.17	28.51	30.96	31.54	32.89
C513d	516352	173919	24.16	25.42	26.05	26.69	27.29	28.17	28.51	30.96	31.54	32.89
C512	516370	173977	24.16	25.42	26.05	26.69	27.29	28.17	28.51	30.96	31.54	32.80
C511	516311	174096	24.16	25.42	26.05	26.69	27.29	28.18	28.51	30.96	31.50	32.14
C510	516281	174173	24.16	25.42	26.05	26.69	27.29	28.18	28.51	30.85	31.35	31.18
C509	516314	174220	24.20	25.43	26.07	26.74	27.30	28.22	28.55	30.86	31.36	32.18
C509d	516314	174220	24.20	25.43	26.07	26.74	27.30	28.22	28.55	30.86	31.36	32.18
C508u	516332	174310	24.20	25.43	26.07	26.74	27.30	28.22	28.55	30.86	31.36	32.17
C508d	516332	174310	24.20	25.43	26.07	26.74	27.30	28.22	28.55	30.86	31.36	32.17
C507	516338	174406	24.20	25.43	26.07	26.74	27.30	28.22	28.55	30.86	31.36	32.16
C507d	516338	174406	24.20	25.43	26.07	26.74	27.30	28.22	28.55	30.86	31.36	32.16
W001	516330	174440	0.21	0.21	0.21	0.26	0.28	0.32	0.34	0.69	1.39	5.89

Detailed FRA centred on: St Margarets Business Park Car Park, Twickenham, TW1 1JS - 03/03/2022 - HNL 253000 NR



Environment Agency
Alchemy,
Bessemer Road,
Welwyn Garden City,
Hertfordshire,
AL7 1HE

N

0 15 30 60
Metres

Legend

Main Rivers

Site location

2D Node Results: Heights

1 in 1000 (0.1%) Defended

The data in this map has been extracted from the River Crane Mapping Study (Halcrow 2008).
This model has been designed for catchment wide flood risk mapping. It should be noted that it was not created to produce flood levels for specific development sites withinthe catchment.
Modelled outlines take into account catchment wide defences.

Flood risk data requests including an allowance for climate change will be based on the 1 in 100 flood plus 20% allowance for climate change, unless otherwise stated. You should refer to 'Flood risk assessments: climate change allowances' to check if this allowance is still appropriate for the type of development you are proposing and its location. You may need to undertake further assessment of future flood risk using different allowances to ensure your assessment of future flood risk is based on best available evidence. https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

Produced by:
Partnerships & Strategic Overview,
Hertfordshire & North London

APPENDIX D
THAMES WATER CORRESPONDENCE

Sewer Flooding
History Enquiry

Property Searches

Simpson Associates

Friday Street

Search address supplied	St Margarets Business Car Park Winchester Road Twickenham TW1 1JS

Your reference	St Margarets Business Car Park
Our reference	SFH/SFH Standard/2020_4207835
Received date	**2 July 2020**
Search date	**2 July 2020**

Thames Water Utilities Ltd
Property Searches, PO Box 3189, Slough SL1 4WW
DX 151280 Slough 13

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

0845 070 9148

Sewer Flooding
History Enquiry

Thames Water Property Searches

Search address supplied: St Margarets Business Car Park,Winchester Road,Twickenham,TW1 1JS

This search is recommended to check for any sewer flooding in a specific address or area

TWUL, trading as Property Searches, are responsible in respect of the following:-

(i) any negligent or incorrect entry in the records searched;

(ii) any negligent or incorrect interpretation of the records searched;

(iii) and any negligent or incorrect recording of that interpretation in the search report

(iv) compensation payments

Thames Water Utilities Ltd
Property Searches, PO Box 3189, Slough SL1 4WW
DX 151280 Slough 13

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

0845 070 9148

History of Sewer Flooding

Is the requested address or area at risk of flooding due to overloaded public sewers?

The flooding records held by Thames Water indicate that there have been no incidents of flooding in the requested area as a result of surcharging public sewers.

For your guidance:

- A sewer is "overloaded" when the flow from a storm is unable to pass through it due to a permanent problem (e.g. flat gradient, small diameter). Flooding as a result of temporary problems such as blockages, siltation, collapses and equipment or operational failures are excluded.
- "Internal flooding" from public sewers is defined as flooding, which enters a building or passes below a suspended floor. For reporting purposes, buildings are restricted to those normally occupied and used for residential, public, commercial, business or industrial purposes.
- "At Risk" properties are those that the water company is required to include in the Regulatory Register that is presented annually to the Director General of Water Services. These are defined as properties that have suffered, or are likely to suffer, internal flooding from public foul, combined or surface water sewers due to overloading of the sewerage system more frequently than the relevant reference period (either once or twice in ten years) as determined by the Company's reporting procedure.
- Flooding as a result of storm events proven to be exceptional and beyond the reference period of one in ten years are not included on the At Risk Register.
- Properties may be at risk of flooding but not included on the Register where flooding incidents have not been reported to the Company.
- Public Sewers are defined as those for which the Company holds statutory responsibility under the Water Industry Act 1991.
- It should be noted that flooding can occur from private sewers and drains which are not the responsibility of the Company. This report excludes flooding from private sewers and drains and the Company makes no comment upon this matter.
- For further information please contact Thames Water on Tel: 0800 316 9800 or website www.thameswater.co.uk

Thames Water Utilities Ltd
Property Searches, PO Box 3189, Slough SL1 4WW
DX 151280 Slough 13

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

0845 070 9148

Mr B Tawton
Simpson Associates
8 Friday st
Henley on Thames
Oxfordshire
RG9 1AH

Our ref: DS6075425

0800 009 3921
Monday to Friday, 8am to 5pm

8th July 2020

Pre-planning enquiry: Wastewater Capacity check

Dear Mr Tawton

Thank you for providing details of your development with the Pre-Planning application dated 2nd July 20 for development @ St. Magarets Buisness Centre Drummond Place Twickenham TW1 1JS

Existing brownfld site ,developed to { 4 dwellings } as per your above application.

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

If your proposals progress in line with the details you've provided as above, we're pleased to confirm that there will be sufficient sewerage capacity in the nearest TW foul sewer network to serve your foul discharges from your development, provided it is by gravity.

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 and has to be investigated again.

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 2 l/s to TW surface water sewer , then Thames Water would not have any objections to the proposal.

Please see the attached ‘Planning your wastewater’ leaflet for additional information. At the appropriate time, you will have to apply for a S106 connection application to DS Connection team

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.

Please note that you must 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 sewerage capacity.

What happens next?

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

If you've any further questions, please contact me.

Yours sincerely

Siva Sivarajan

Developer Services- Wastewater Adoptions Engineer
Office:0203 577 7752 Mobile: 07747842608
siva.sivarajan@thameswater.co.uk

Thames Water Utilities Ltd, Clearwater Court, Vastern Road, Reading, Berkshire, RG1 8DB
Find us online at developers.thameswater.co.uk

Thames Water

TW Int ref : DTS 66298

APPENDIX E
LONDON SUSTAINABLE DRAINAGE PROFORMA

1. Project & Site Details

Project / Site Name (including sub-catchment / stage / phase where appropriate)	St Margaret's Business Car Park
Address & post code	Moor Mead Road Twickenham TW1 1JS
OS Grid ref. (Easting, Northing)	E 516645 N 174123
LPA reference (if applicable)	N/A
Brief description of proposed work	The proposed development comprises 3 No. residential dwellings with associated gardens and parking spaces.
Total site Area	628 m^2
Total existing impervious area	628 m^2
Total proposed impervious area	628 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 in Godstone Road.
Designer Name	Gareth Crowther
Designer Position	Partner
Designer Company	Simpson TWS

2. Proposed Discharge Arrangements

2a. Infiltration Feasibility

Superficial geology classification	Kempton Park Gravel Member	
Bedrock geology classification	London Clay	
Site infiltration rate	N/A	m/s
Depth to groundwater level	Not known	m below ground level
Is infiltration feasible?	No	

2b. Drainage Hierarchy

	Feasible (Y/N)	*Proposed (Y/N)*
1 store rainwater for later use	Y	Y
2 use infiltration techniques, such as porous surfaces in non-clay areas	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 in Godstone Road
Has the owner/regulator of the discharge location been consulted?	Yes

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	0.9			
1 in 1	0.7	2.3	1.7	0.7
1 in 30	1.5	5.1	4.5	1.2
1 in 100	1.7	6.6	6.2	1.4
1 in 100 + CC			9.1	1.7
Climate change allowance used		40%		

3b. Principal Method of Flow Control	Pervious Pavement & Hydrobrake flow control

3c. Proposed SuDS Measures

	Catchment area (m^2)	*Plan area (m^2)*	*Storage vol. (m^3)*
Rainwater harvesting	0		0
Infiltration systems	0		0
Green roofs	0	0	0
Blue roofs	0	0	0
Filter strips	0	0	0
Filter drains	0	0	0
Bioretention / tree pits	0	0	0
Pervious pavements	58.4	0	9.2
Swales	0	0	0
Basins/ponds	0	0	0
Attenuation tanks	0		0
Total	**58.4**	**0**	**9.2**

4. Supporting Information

4a. Discharge & Drainage Strategy	*Page/section of drainage report*
Infiltration feasibility (2a) – geotechnical factual and interpretive reports, including infiltration results	Page 4 / Paragraph 2.4
Drainage hierarchy (2b)	Page 16 / Table 1
Proposed discharge details (2c) – utility plans, correspondence / approval from owner/regulator of discharge location	Appendix D
Discharge rates & storage (3a) – detailed hydrologic and hydraulic calculations	Appendix F & H
Proposed SuDS measures & specifications (3b)	Page 19 / Paragraph 8.18

4b. Other Supporting Details	*Page/section of drainage report*
Detailed Development Layout	Appendix B
Detailed drainage design drawings, including exceedance flow routes	Appendix G
Detailed landscaping plans	Appendix B
Maintenance strategy	Page 21 / Paragraph 8.27
Demonstration of how the proposed SuDS measures improve:	
a) water quality of the runoff?	Page 21 / Table 6
b) biodiversity?	Page 21 / Paragraph 8.26
c) amenity?	Page 21 / Paragraph 8.26

APPENDIX F
RUNOFF CALCULATIONS

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.500
Area (ha)	0.060	Urban	0.750
SAAR (mm)	700	Region Number	Region 6

Results	**l/s**
QBAR Rural	0.3
QBAR Urban	0.9
Q100 years	1.7
Q1 year	0.7
Q30 years	1.5
Q100 years	1.7

P20-435, St Margarets Business Car Park - Modified Rational Method Runoff Calculations (Pre-Development)

Peak Runoff Rate = 3.61 x Runoff Volume Coefficient (Cv) x Area (A) x Peak Rainfall Intensity (I_{peak})

Runoff Volume = Runoff Coefficient (C) x Area (A) x Average Rainfall intensity (I_{ave}) x Storm Duration

Pre-development Runoff

Return Period	Cv	$I_{(peak)}$ (mm)	$I_{(ave)}$ (mm)	A (Ha)	Peak Runoff Rate (l/s)	Runoff Volume (m^3)
1	0.75	14.118	3.601	0.060	2.3	9.7
30	0.75	31.172	7.952	0.060	5.1	21.5
100	0.75	40.444	10.317	0.060	6.6	27.9

Notes

1. Rainfall intensities generated from the FSR rainfall model facility in MicroDrainage.
2. Peak and average rainfall intensities are based on the following FSR data:

Storm Duration:	360 min (6hrs)
M5-60 (mm):	20.000
Ratio R	0.410

APPENDIX G
PROPOSED DRAINAGE STRATEGY PLAN

LEGEND

- PROPOSED SURFACE WATER DRAINAGE
- PROPOSED COLLECTOR / DISTRIBUTOR DRAIN
- PROPOSED PERMEABLE PAVING AREA = 58m²
- SITE BOUNDARY.

DO NOT SCALE

A1

MK	REVISION	BY	DATE
P1	First Issue	GSC	11.03.22

DRAWING STATUS

PLANNING

DRAWING TITLE

SURFACE WATER DRAINAGE STRATEGY PLAN

PROJECT

Project Number P20-435

ST MARGARET'S BUSINESS CENTRE
MOOR MEAD ROAD
TWICKENHAM TW1 1JS

simpson | tws

8 Friday Street
Henley on Thames
Oxfordshire RG9 1AH
T.01491 576221

London, Henley-on Thames, Gloucester and Exeter

Drawn	Ch'kd	Scales	Date
J.J.H.	G.S.C.	1:100@A1	AUG'20

Purpose of Issue

PLANNING

Drawing Number	Revision
P20-435A-SK01	P1

APPENDIX H
DRAINAGE STRATEGY DESIGN RESULTS

Model Details

Storage is Online Cover Level (m) 6.250

Porous Car Park Structure

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	4.0
Membrane Percolation (mm/hr)	1000	Length (m)	14.6
Max Percolation (l/s)	16.2	Slope (1:X)	0.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	5.515	Membrane Depth (m)	0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SCU-0046-1700-0525-1700
Design Head (m)	0.525
Design Flow (l/s)	1.7
Flush-Flo™	Calculated
Objective	Linear discharge profile
Application	Surface
Sump Available	Yes
Diameter (mm)	46
Invert Level (m)	5.540
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	**Head (m)**	**Flow (l/s)**
Design Point (Calculated)	0.525	1.7
Flush-Flo™	0.069	0.7
Kick-Flo®	0.069	0.7
Mean Flow over Head Range	-	1.2

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	0.8	1.200	2.5	3.000	3.8	7.000	5.7
0.200	1.1	1.400	2.7	3.500	4.1	7.500	5.9
0.300	1.3	1.600	2.8	4.000	4.4	8.000	6.1
0.400	1.5	1.800	3.0	4.500	4.6	8.500	6.3
0.500	1.7	2.000	3.1	5.000	4.8	9.000	6.5
0.600	1.8	2.200	3.3	5.500	5.1	9.500	6.7
0.800	2.1	2.400	3.4	6.000	5.3		
1.000	2.3	2.600	3.6	6.500	5.5		

Summary of Results for 1 year Return Period

Half Drain Time : 42 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	5.579	0.064	0.0	0.4	0.4	1.1	O K
30 min Summer	5.592	0.077	0.0	0.6	0.6	1.3	O K
60 min Summer	5.602	0.087	0.0	0.7	0.7	1.5	O K
120 min Summer	5.605	0.090	0.0	0.7	0.7	1.6	O K
180 min Summer	5.603	0.088	0.0	0.7	0.7	1.5	O K
240 min Summer	5.599	0.084	0.0	0.6	0.6	1.5	O K
360 min Summer	5.592	0.077	0.0	0.6	0.6	1.4	O K
480 min Summer	5.586	0.071	0.0	0.5	0.5	1.2	O K
600 min Summer	5.582	0.067	0.0	0.5	0.5	1.2	O K
720 min Summer	5.579	0.064	0.0	0.4	0.4	1.1	O K
960 min Summer	5.574	0.059	0.0	0.4	0.4	1.0	O K
1440 min Summer	5.569	0.054	0.0	0.3	0.3	0.9	O K
2160 min Summer	5.564	0.049	0.0	0.2	0.2	0.9	O K
2880 min Summer	5.562	0.047	0.0	0.2	0.2	0.8	O K
4320 min Summer	5.558	0.043	0.0	0.1	0.1	0.8	O K
5760 min Summer	5.556	0.041	0.0	0.1	0.1	0.7	O K
7200 min Summer	5.555	0.040	0.0	0.1	0.1	0.7	O K
8640 min Summer	5.554	0.039	0.0	0.1	0.1	0.7	O K
10080 min Summer	5.553	0.038	0.0	0.1	0.1	0.7	O K
15 min Winter	5.588	0.073	0.0	0.5	0.5	1.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	31.246	0.0	0.8	16
30 min Summer	20.306	0.0	1.3	25
60 min Summer	12.800	0.0	1.9	42
120 min Summer	7.903	0.0	2.5	74
180 min Summer	5.931	0.0	2.8	106
240 min Summer	4.833	0.0	3.2	136
360 min Summer	3.601	0.0	3.6	196
480 min Summer	2.913	0.0	3.9	256
600 min Summer	2.471	0.0	4.2	314
720 min Summer	2.161	0.0	4.4	376
960 min Summer	1.748	0.0	4.8	492
1440 min Summer	1.296	0.0	5.4	736
2160 min Summer	0.962	0.0	6.0	1100
2880 min Summer	0.779	0.0	6.5	1456
4320 min Summer	0.577	0.0	7.2	2200
5760 min Summer	0.467	0.0	7.6	2936
7200 min Summer	0.396	0.0	8.0	3664
8640 min Summer	0.347	0.0	8.3	4408
10080 min Summer	0.310	0.0	8.6	5096
15 min Winter	31.246	0.0	1.0	16

Summary of Results for 1 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control Σ (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	5.602	0.087	0.0	0.7	0.7	1.5	O K
60 min Winter	5.611	0.096	0.0	0.7	0.7	1.7	O K
120 min Winter	5.609	0.094	0.0	0.7	0.7	1.6	O K
180 min Winter	5.602	0.087	0.0	0.7	0.7	1.5	O K
240 min Winter	5.595	0.080	0.0	0.6	0.6	1.4	O K
360 min Winter	5.586	0.071	0.0	0.5	0.5	1.2	O K
480 min Winter	5.580	0.065	0.0	0.4	0.4	1.1	O K
600 min Winter	5.575	0.060	0.0	0.4	0.4	1.1	O K
720 min Winter	5.573	0.058	0.0	0.3	0.3	1.0	O K
960 min Winter	5.569	0.054	0.0	0.3	0.3	0.9	O K
1440 min Winter	5.564	0.049	0.0	0.2	0.2	0.9	O K
2160 min Winter	5.560	0.045	0.0	0.1	0.1	0.8	O K
2880 min Winter	5.558	0.043	0.0	0.1	0.1	0.8	O K
4320 min Winter	5.555	0.040	0.0	0.1	0.1	0.7	O K
5760 min Winter	5.554	0.039	0.0	0.1	0.1	0.7	O K
7200 min Winter	5.553	0.038	0.0	0.1	0.1	0.7	O K
8640 min Winter	5.552	0.037	0.0	0.1	0.1	0.6	O K
10080 min Winter	5.551	0.036	0.0	0.1	0.1	0.6	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	20.306	0.0	1.6	26
60 min Winter	12.800	0.0	2.2	44
120 min Winter	7.903	0.0	2.8	80
180 min Winter	5.931	0.0	3.3	110
240 min Winter	4.833	0.0	3.6	142
360 min Winter	3.601	0.0	4.1	200
480 min Winter	2.913	0.0	4.5	258
600 min Winter	2.471	0.0	4.8	320
720 min Winter	2.161	0.0	5.1	376
960 min Winter	1.748	0.0	5.5	492
1440 min Winter	1.296	0.0	6.1	734
2160 min Winter	0.962	0.0	6.9	1104
2880 min Winter	0.779	0.0	7.4	1452
4320 min Winter	0.577	0.0	8.2	2204
5760 min Winter	0.467	0.0	8.7	2936
7200 min Winter	0.396	0.0	9.2	3560
8640 min Winter	0.347	0.0	9.6	4408
10080 min Winter	0.310	0.0	9.9	5120

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.410	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.027

Time From:	**(mins) To:**	**Area (ha)**
0	4	0.027

Summary of Results for 30 year Return Period

Half Drain Time : 46 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	5.691	0.176	0.0	1.0	1.0	3.1	O K
30 min Summer	5.727	0.212	0.0	1.1	1.1	3.7	O K
60 min Summer	5.747	0.232	0.0	1.1	1.1	4.1	O K
120 min Summer	5.747	0.232	0.0	1.1	1.1	4.1	O K
180 min Summer	5.733	0.218	0.0	1.1	1.1	3.8	O K
240 min Summer	5.716	0.201	0.0	1.0	1.0	3.5	O K
360 min Summer	5.685	0.170	0.0	1.0	1.0	3.0	O K
480 min Summer	5.661	0.146	0.0	0.9	0.9	2.6	O K
600 min Summer	5.643	0.128	0.0	0.8	0.8	2.2	O K
720 min Summer	5.628	0.113	0.0	0.8	0.8	2.0	O K
960 min Summer	5.607	0.092	0.0	0.7	0.7	1.6	O K
1440 min Summer	5.589	0.074	0.0	0.6	0.6	1.3	O K
2160 min Summer	5.578	0.063	0.0	0.4	0.4	1.1	O K
2880 min Summer	5.573	0.058	0.0	0.3	0.3	1.0	O K
4320 min Summer	5.567	0.052	0.0	0.2	0.2	0.9	O K
5760 min Summer	5.564	0.049	0.0	0.2	0.2	0.8	O K
7200 min Summer	5.561	0.046	0.0	0.2	0.2	0.8	O K
8640 min Summer	5.560	0.045	0.0	0.1	0.1	0.8	O K
10080 min Summer	5.558	0.043	0.0	0.1	0.1	0.8	O K
15 min Winter	5.716	0.201	0.0	1.0	1.0	3.5	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	76.671	0.0	3.1	17
30 min Summer	49.712	0.0	4.3	29
60 min Summer	30.811	0.0	5.5	44
120 min Summer	18.537	0.0	6.8	78
180 min Summer	13.628	0.0	7.5	112
240 min Summer	10.910	0.0	8.1	144
360 min Summer	7.952	0.0	8.9	208
480 min Summer	6.352	0.0	9.5	268
600 min Summer	5.333	0.0	10.0	328
720 min Summer	4.621	0.0	10.4	388
960 min Summer	3.685	0.0	11.1	502
1440 min Summer	2.675	0.0	12.1	738
2160 min Summer	1.940	0.0	13.1	1100
2880 min Summer	1.543	0.0	13.9	1468
4320 min Summer	1.117	0.0	15.0	2200
5760 min Summer	0.887	0.0	15.8	2912
7200 min Summer	0.742	0.0	16.4	3664
8640 min Summer	0.641	0.0	16.9	4376
10080 min Summer	0.567	0.0	17.3	5040
15 min Winter	76.671	0.0	3.6	17

Summary of Results for 30 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	5.756	0.241	0.0	1.1	1.1	4.2	O K
60 min Winter	5.775	0.260	0.0	1.2	1.2	4.5	O K
120 min Winter	5.765	0.250	0.0	1.2	1.2	4.4	O K
180 min Winter	5.740	0.225	0.0	1.1	1.1	4.0	O K
240 min Winter	5.715	0.200	0.0	1.0	1.0	3.5	O K
360 min Winter	5.673	0.158	0.0	0.9	0.9	2.8	O K
480 min Winter	5.643	0.128	0.0	0.8	0.8	2.2	O K
600 min Winter	5.621	0.106	0.0	0.7	0.7	1.9	O K
720 min Winter	5.605	0.090	0.0	0.7	0.7	1.6	O K
960 min Winter	5.591	0.076	0.0	0.6	0.6	1.3	O K
1440 min Winter	5.578	0.063	0.0	0.4	0.4	1.1	O K
2160 min Winter	5.571	0.056	0.0	0.3	0.3	1.0	O K
2880 min Winter	5.567	0.052	0.0	0.2	0.2	0.9	O K
4320 min Winter	5.562	0.047	0.0	0.2	0.2	0.8	O K
5760 min Winter	5.560	0.045	0.0	0.1	0.1	0.8	O K
7200 min Winter	5.558	0.043	0.0	0.1	0.1	0.7	O K
8640 min Winter	5.556	0.041	0.0	0.1	0.1	0.7	O K
10080 min Winter	5.555	0.040	0.0	0.1	0.1	0.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	49.712	0.0	4.9	30
60 min Winter	30.811	0.0	6.2	48
120 min Winter	18.537	0.0	7.7	84
180 min Winter	13.628	0.0	8.5	120
240 min Winter	10.910	0.0	9.1	154
360 min Winter	7.952	0.0	10.0	218
480 min Winter	6.352	0.0	10.7	278
600 min Winter	5.333	0.0	11.3	338
720 min Winter	4.621	0.0	11.8	390
960 min Winter	3.685	0.0	12.5	504
1440 min Winter	2.675	0.0	13.6	738
2160 min Winter	1.940	0.0	14.8	1104
2880 min Winter	1.543	0.0	15.7	1468
4320 min Winter	1.117	0.0	17.0	2152
5760 min Winter	0.887	0.0	17.9	2912
7200 min Winter	0.742	0.0	18.6	3624
8640 min Winter	0.641	0.0	19.2	4248
10080 min Winter	0.567	0.0	19.6	5040

Rainfall Details

Rainfall Model	FSR	Winter Storms	Yes
Return Period (years)	30	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	20.000	Shortest Storm (mins)	15
Ratio R	0.410	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.027

Time From:	**(mins) To:**	**Area (ha)**
0	4	0.027

Summary of Results for 100 year Return Period

Half Drain Time : 44 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	5.751	0.236	0.0	1.1	1.1	4.1	O K
30 min Summer	5.803	0.288	0.0	1.2	1.2	5.0	O K
60 min Summer	5.830	0.315	0.0	1.3	1.3	5.5	O K
120 min Summer	5.831	0.316	0.0	1.3	1.3	5.5	O K
180 min Summer	5.813	0.298	0.0	1.3	1.3	5.2	O K
240 min Summer	5.791	0.276	0.0	1.2	1.2	4.8	O K
360 min Summer	5.750	0.235	0.0	1.1	1.1	4.1	O K
480 min Summer	5.717	0.202	0.0	1.0	1.0	3.5	O K
600 min Summer	5.691	0.176	0.0	1.0	1.0	3.1	O K
720 min Summer	5.670	0.155	0.0	0.9	0.9	2.7	O K
960 min Summer	5.639	0.124	0.0	0.8	0.8	2.2	O K
1440 min Summer	5.604	0.089	0.0	0.7	0.7	1.6	O K
2160 min Summer	5.587	0.072	0.0	0.5	0.5	1.3	O K
2880 min Summer	5.579	0.064	0.0	0.4	0.4	1.1	O K
4320 min Summer	5.571	0.056	0.0	0.3	0.3	1.0	O K
5760 min Summer	5.567	0.052	0.0	0.2	0.2	0.9	O K
7200 min Summer	5.564	0.049	0.0	0.2	0.2	0.9	O K
8640 min Summer	5.562	0.047	0.0	0.2	0.2	0.8	O K
10080 min Summer	5.560	0.045	0.0	0.1	0.1	0.8	O K
15 min Winter	5.783	0.268	0.0	1.2	1.2	4.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	99.536	0.0	4.3	17
30 min Summer	65.075	0.0	5.8	30
60 min Summer	40.510	0.0	7.5	46
120 min Summer	24.362	0.0	9.1	80
180 min Summer	17.855	0.0	10.1	114
240 min Summer	14.239	0.0	10.8	148
360 min Summer	10.317	0.0	11.8	212
480 min Summer	8.210	0.0	12.5	274
600 min Summer	6.871	0.0	13.1	334
720 min Summer	5.939	0.0	13.6	394
960 min Summer	4.714	0.0	14.4	512
1440 min Summer	3.400	0.0	15.6	740
2160 min Summer	2.448	0.0	16.9	1100
2880 min Summer	1.937	0.0	17.7	1468
4320 min Summer	1.391	0.0	19.0	2180
5760 min Summer	1.099	0.0	19.9	2912
7200 min Summer	0.915	0.0	20.6	3672
8640 min Summer	0.787	0.0	21.2	4376
10080 min Summer	0.693	0.0	21.6	5136
15 min Winter	99.536	0.0	4.9	17

Summary of Results for 100 year Return Period

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control Σ (l/s)	Max Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	5.843	0.328	0.0	1.3	1.3	5.7	O K
60 min Winter	5.870	0.355	0.0	1.4	1.4	6.2	O K
120 min Winter	5.861	0.346	0.0	1.4	1.4	6.1	O K
180 min Winter	5.831	0.316	0.0	1.3	1.3	5.5	O K
240 min Winter	5.798	0.283	0.0	1.2	1.2	5.0	O K
360 min Winter	5.741	0.226	0.0	1.1	1.1	4.0	O K
480 min Winter	5.698	0.183	0.0	1.0	1.0	3.2	O K
600 min Winter	5.666	0.151	0.0	0.9	0.9	2.6	O K
720 min Winter	5.642	0.127	0.0	0.8	0.8	2.2	O K
960 min Winter	5.610	0.095	0.0	0.7	0.7	1.7	O K
1440 min Winter	5.587	0.072	0.0	0.5	0.5	1.3	O K
2160 min Winter	5.576	0.061	0.0	0.4	0.4	1.1	O K
2880 min Winter	5.571	0.056	0.0	0.3	0.3	1.0	O K
4320 min Winter	5.565	0.050	0.0	0.2	0.2	0.9	O K
5760 min Winter	5.562	0.047	0.0	0.2	0.2	0.8	O K
7200 min Winter	5.560	0.045	0.0	0.1	0.1	0.8	O K
8640 min Winter	5.558	0.043	0.0	0.1	0.1	0.8	O K
10080 min Winter	5.557	0.042	0.0	0.1	0.1	0.7	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	65.075	0.0	6.6	30
60 min Winter	40.510	0.0	8.4	48
120 min Winter	24.362	0.0	10.3	86
180 min Winter	17.855	0.0	11.4	122
240 min Winter	14.239	0.0	12.2	158
360 min Winter	10.317	0.0	13.3	222
480 min Winter	8.210	0.0	14.1	286
600 min Winter	6.871	0.0	14.8	346
720 min Winter	5.939	0.0	15.3	404
960 min Winter	4.714	0.0	16.3	520
1440 min Winter	3.400	0.0	17.6	750
2160 min Winter	2.448	0.0	19.0	1100
2880 min Winter	1.937	0.0	20.0	1468
4320 min Winter	1.391	0.0	21.5	2132
5760 min Winter	1.099	0.0	22.5	2936
7200 min Winter	0.915	0.0	23.3	3672
8640 min Winter	0.787	0.0	23.9	4256
10080 min Winter	0.693	0.0	24.5	5176

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	0.410	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+0

Time Area Diagram

Total Area (ha) 0.027

Time From:	(mins) To:	Area (ha)
0	4	0.027

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

Half Drain Time : 55 minutes.

Storm Event	Max Level (m)	Max Depth (m)	Max Infiltration (l/s)	Max Control (l/s)	Max Σ Outflow (l/s)	Max Volume (m³)	Status
15 min Summer	5.857	0.342	0.0	1.4	1.4	6.0	O K
30 min Summer	5.934	0.419	0.0	1.5	1.5	7.3	O K
60 min Summer	5.975	0.460	0.0	1.6	1.6	8.1	O K
120 min Summer	5.980	0.465	0.0	1.6	1.6	8.1	O K
180 min Summer	5.958	0.443	0.0	1.5	1.5	7.8	O K
240 min Summer	5.929	0.414	0.0	1.5	1.5	7.3	O K
360 min Summer	5.875	0.360	0.0	1.4	1.4	6.3	O K
480 min Summer	5.830	0.315	0.0	1.3	1.3	5.5	O K
600 min Summer	5.792	0.277	0.0	1.2	1.2	4.9	O K
720 min Summer	5.761	0.246	0.0	1.2	1.2	4.3	O K
960 min Summer	5.714	0.199	0.0	1.0	1.0	3.5	O K
1440 min Summer	5.654	0.139	0.0	0.9	0.9	2.4	O K
2160 min Summer	5.609	0.094	0.0	0.7	0.7	1.6	O K
2880 min Summer	5.593	0.078	0.0	0.6	0.6	1.4	O K
4320 min Summer	5.579	0.064	0.0	0.4	0.4	1.1	O K
5760 min Summer	5.573	0.058	0.0	0.3	0.3	1.0	O K
7200 min Summer	5.569	0.054	0.0	0.3	0.3	0.9	O K
8640 min Summer	5.567	0.052	0.0	0.2	0.2	0.9	O K
10080 min Summer	5.565	0.050	0.0	0.2	0.2	0.9	O K
15 min Winter	5.902	0.387	0.0	1.4	1.4	6.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	139.350	0.0	6.3	17
30 min Summer	91.106	0.0	8.5	31
60 min Summer	56.713	0.0	10.7	48
120 min Summer	34.106	0.0	13.1	82
180 min Summer	24.997	0.0	14.4	116
240 min Summer	19.934	0.0	15.4	150
360 min Summer	14.444	0.0	16.8	216
480 min Summer	11.493	0.0	17.8	280
600 min Summer	9.620	0.0	18.7	342
720 min Summer	8.314	0.0	19.4	404
960 min Summer	6.600	0.0	20.5	522
1440 min Summer	4.760	0.0	22.2	764
2160 min Summer	3.427	0.0	24.0	1108
2880 min Summer	2.712	0.0	25.3	1468
4320 min Summer	1.948	0.0	27.1	2200
5760 min Summer	1.538	0.0	28.5	2936
7200 min Summer	1.281	0.0	29.5	3656
8640 min Summer	1.102	0.0	30.4	4368
10080 min Summer	0.970	0.0	31.0	5128
15 min Winter	139.350	0.0	7.2	17

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)	Σ Max Outflow (l/s)	Max Volume (m³)	Status
30 min Winter	5.991	0.476	0.0	1.6	1.6	8.3	O K
60 min Winter	6.036	0.521	0.0	1.7	1.7	9.1	O K
120 min Winter	6.032	0.517	0.0	1.7	1.7	9.1	O K
180 min Winter	5.995	0.480	0.0	1.6	1.6	8.4	O K
240 min Winter	5.952	0.437	0.0	1.5	1.5	7.7	O K
360 min Winter	5.875	0.360	0.0	1.4	1.4	6.3	O K
480 min Winter	5.814	0.299	0.0	1.3	1.3	5.2	O K
600 min Winter	5.766	0.251	0.0	1.2	1.2	4.4	O K
720 min Winter	5.728	0.213	0.0	1.1	1.1	3.7	O K
960 min Winter	5.674	0.159	0.0	0.9	0.9	2.8	O K
1440 min Winter	5.615	0.100	0.0	0.7	0.7	1.8	O K
2160 min Winter	5.588	0.073	0.0	0.5	0.5	1.3	O K
2880 min Winter	5.579	0.064	0.0	0.4	0.4	1.1	O K
4320 min Winter	5.571	0.056	0.0	0.3	0.3	1.0	O K
5760 min Winter	5.567	0.052	0.0	0.2	0.2	0.9	O K
7200 min Winter	5.564	0.049	0.0	0.2	0.2	0.9	O K
8640 min Winter	5.562	0.047	0.0	0.2	0.2	0.8	O K
10080 min Winter	5.561	0.046	0.0	0.2	0.2	0.8	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
30 min Winter	91.106	0.0	9.6	31
60 min Winter	56.713	0.0	12.1	52
120 min Winter	34.106	0.0	14.7	88
180 min Winter	24.997	0.0	16.3	126
240 min Winter	19.934	0.0	17.3	162
360 min Winter	14.444	0.0	18.9	228
480 min Winter	11.493	0.0	20.1	294
600 min Winter	9.620	0.0	21.0	356
720 min Winter	8.314	0.0	21.8	418
960 min Winter	6.600	0.0	23.1	538
1440 min Winter	4.760	0.0	25.0	766
2160 min Winter	3.427	0.0	27.0	1104
2880 min Winter	2.712	0.0	28.4	1464
4320 min Winter	1.948	0.0	30.5	2204
5760 min Winter	1.538	0.0	32.1	2808
7200 min Winter	1.281	0.0	33.2	3744
8640 min Winter	1.102	0.0	34.2	4352
10080 min Winter	0.970	0.0	35.0	5216

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	0.410	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.027

Time From:	**(mins) To:**	**Area (ha)**
0	4	0.027

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