

71 – 73 CAVERSHAM ROAD, READING

Flood Risk Assessment and Surface Water Drainage Strategy



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FRA and SuDS Strategy
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REPORT

Quality Management

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EXECUTIVE SUMMARY

RPS was commissioned to undertake a Flood Risk Assessment and Surface Water Drainage Strategy to support the redevelopment of 71-73 Caversham Road, Reading RG1 8JA to provide 44 residential units and a ground floor retail unit. The three existing office units in the west of the site will be retained.

The site is located within the Environment Agency (EA)'s Flood Zone 2 associated with fluvial flooding from the River Thames. When a climate change allowance is applied the site would be located within the 1 in 100 year flood extent. Therefore, all residential accommodation will be located at first floor level and above, significantly above the modelled fluvial flood level. Flood resistance and resilience techniques are recommended to be incorporated at ground floor level, up to the 1 in 100 year plus 35% climate change flood level of 38.35m AOD. This will help minimise the damage caused and reduce the time in which the retail unit cannot operate, should flooding occur.

Whilst safe access and egress is not available during a 1 in 100 year plus climate change event, it is recommended that site management and residents sign up to receive free flood warnings from the EA. The residential units themselves comprise safe refuge and it is considered that adequate warning will be provided for the retail unit to be evacuated, especially given the proximity of an area wholly outside of the floodplain. It is recommended that a Flood Management Plan is prepared to detail the actions to be taken before, during and after a potential flood event.

No significant risks were identified in relation to flooding from non-fluvial sources. In line with Building Regulations, it is recommended that the ground floor level is elevated 150mm above surrounding ground levels to help mitigate the increase of floodwater from other sources, should an extreme event occur.

It is proposed to incorporate permeable paving and underground attenuation crates to reduce the surface water discharge rate to 2 l/s. The permeable paving will additionally provide water quality benefits, prior to discharge to the Thames Water surface water sewer.

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1 INTRODUCTION

- 1.1 RPS was commissioned to undertake a Flood Risk Assessment (FRA) of 71-73 Caversham Road, Reading RG1 8JA in relation to the proposed redevelopment of the site to provide 44 residential flats and retail space.
- 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 Reading Borough Council Strategic Flood Risk Assessment (SFRA).
- 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.

Local Planning Policy

- 2.4 The Reading Borough Council (RBC) Core Strategy was originally published in January 2008 and was altered in January 2015. It contains the following Policies relating to flood risk and drainage:

Core Strategy

Policy CS1: Sustainable Construction and Design

- 2.5 *Proposals for new development, including the construction of new buildings and the redevelopment and refurbishment of existing building stock, will be acceptable where the design of buildings and site layouts use energy, water, minerals, materials and other natural resources appropriately, efficiently and with care and take account of the effects of climate change.*
- 2.6 *To meet these requirements: -*
- 2.7 *[...] Developments incorporate sustainable urban drainage facilities and techniques as part of the layout of a development as appropriate and as advised by the Environment Agency, including minimising the size of impermeable areas so that peak run-off and annual water run-off is reduced where possible and in any case is no greater than the original conditions of the site. Particular care will be needed in areas of flood risk where different solutions may be required.*

Policy CS34: Pollution and Water Resources

- 2.8 [...] *Flooding*
- 2.9 *PPS25 indicates that proposals for development in areas of a medium and high risk of flooding need to be assessed against a sequential test and, if appropriate, an exceptions test.*
- 2.10 *The overall drive of National (PPG and PPS 25), regional (RPG 9 and the South East Plan) and strategic (Berkshire Structure Plan) policy is to direct development away from areas that are liable to flooding. Where this is not possible, i.e. in circumstances where there is nowhere else for development to be accommodated, development should be directed towards the areas of lowest flood risk through the application of the sequential test and, if appropriate, an exceptions test.*

Policy CS35: Flooding

- 2.11 *Planning permission will not be permitted for development in an area identified as being at high risk of flooding, where development would reduce the capacity of the flood plain to store floodwater, impede the flow of floodwater or in any way increase the risks to life and property arising from flooding.*

Reading Central Area Action Plan

- 2.12 The site was not identified as a proposed development site in the Reading Central Area Action Plan (RCAAP) published in 2009 and therefore has not be specifically assessed in this document. The document does, however, acknowledge the areas of Flood Zone 2 and 3 within central Reading and identify that this should be weighed up against the need for redevelopment.

New Local Plan

- 2.13 RBC are currently in the process of preparing a new Local Plan. The Pre-Submission Draft Local Plan, published in November 2017, contains the following relevant policy:

EN 17: Flood Risk and Sustainable Drainage Systems

- 2.14 *Development will be directed to areas at lowest risk of flooding in the first instance, following the Sequential and Exceptions Test set out in the NPPF, and taking into account the effects of climate change. It will consider flooding from all sources, including fluvial, surface water, groundwater and sewer flooding. Where development in areas at risk of flooding is necessary, it will not reduce the capacity of the flood plain to store floodwater, impede the flow of floodwater or in any way increase the risks to life and property arising from flooding. Wherever possible, development should be designed to reduce flood risk, both on- and off-site.*
- 2.15 *All major developments must incorporate sustainable drainage systems (SuDS) as appropriate and in line with the Government's Technical Standards. Smaller schemes are encouraged to incorporate SuDS, where possible. Runoff rates should aim to reflect greenfield conditions and, in any case, must be no greater than the existing conditions of the site. Schemes should ensure that the movement of water through vertical infiltration as well as horizontal run-off does not worsen contamination effects. Wherever possible, SuDS provision should maximise ecological benefits, link into the existing Green Network, incorporate tree planting and landscaping and avoid damage to existing significant trees, including through changes to the site hydrology. All new developments in areas of flood risk should give priority to SuDS.*

Strategic Flood Risk Assessment (SFRA)

- 2.16 The RBC 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. It also contains the following requirements for new developments:

- 2.17 *'Developments within Zone 3a High Probability and Zone 2 Medium Probability, and are NOT offered protection from flood defences:*
- Dry escape, above the 1 in 100 flood level taking into account climate change, should be provided for all 'more vulnerable' (including residential) and 'highly vulnerable' development;*
 - 'Safe' should preferably be dry for all other uses such as educational establishments, hotels and 'less vulnerable' land use classifications.'*
- 2.18 *Finished floor levels should be 'situated a minimum of 300mm above the 1 in 100 year river flood level, including climate change'.*
- 2.19 *'Implement SuDS to ensure that runoff from the site (post redevelopment) does not exceed greenfield runoff rates.'*

3 CONSULTATION

Environment Agency

- 3.1 Modelled flood level data has been requested from the EA, as well as details of historic flooding and flood defences within the vicinity of the site. The information provided by the EA is included as Appendix A and is summarised in Section 6.

Thames Water

- 3.2 The public sewer network within the vicinity of the site is operated by Thames Water.
- 3.3 A pre-development enquiry has been made to Thames Water. They have advised that they would consider restricting surface water runoff rates to 2 l/s as a betterment and are therefore content with connecting to the sewer if there is no suitable alternative. The response from Thames Water is provided in Appendix B.
- 3.4 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 / Local Planning Authority

- 3.5 The site is within the administrative boundary of RBC who are both the Local Planning Authority and Lead Local Flood Authority.
- 3.6 Consultation has been undertaken with a Transport Development Control Manager who is understood to be part of the LLFA. They advised the following:
- 2 l/s is acceptable as the lowest practical minimum runoff rate to provide a self-cleaning system.
 - Use of BGS mapping is sufficient as a means to rule out the use of infiltration techniques
 - The drainage strategy will have to take all land within the red line boundary into account, regardless of the existence of building footprint which will be retained.
- 3.7 Consultation has been undertaken with the Emergency Planning Department regarding the absence of a route of safe access and egress during a 1 in 100 year plus climate change event. They have advised that they would not accept a Flood Management Plan as a means for managing the absence of safe access and egress.

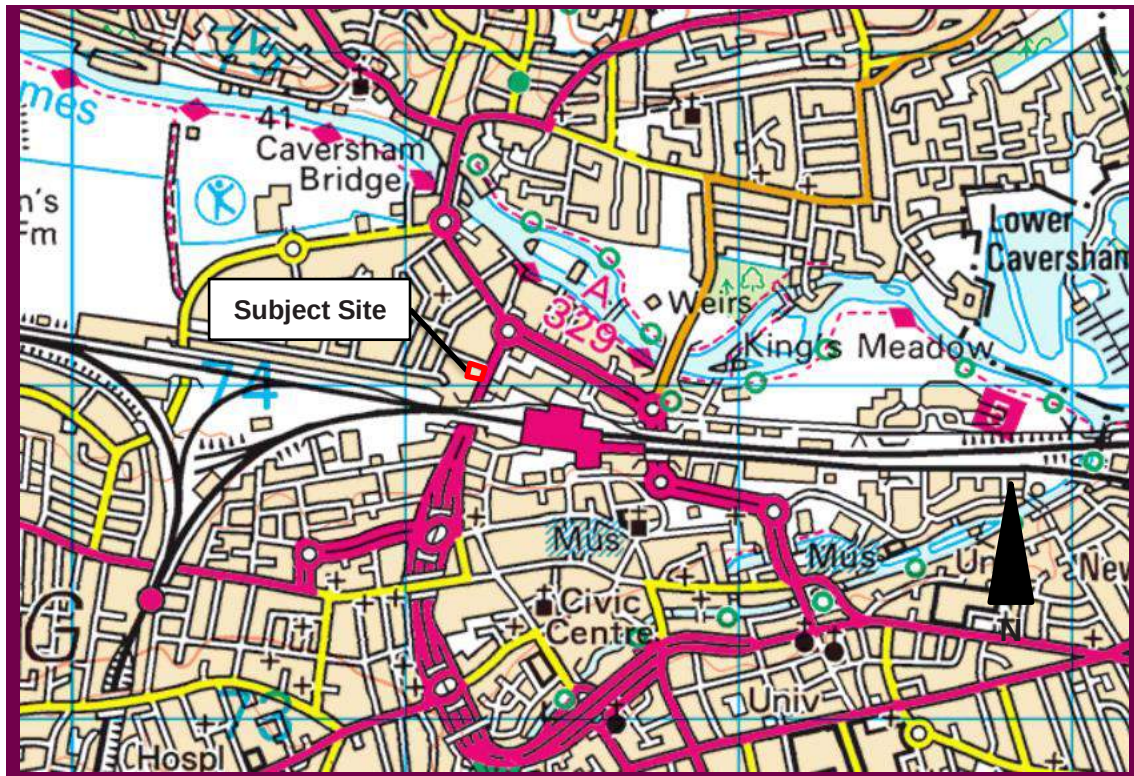
Internal Drainage Board

- 3.8 The site is not located within an IDB District.

4 SITE DESCRIPTION

Site Description

- 4.1 The site is located at National Grid Reference SU 71236 74038. It is rectangular in shape, occupying an area of approximately 0.16 hectares (ha). The site location is presented in Figure 1.



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Figure 1. Site Location

- 4.2 The site is currently occupied by a vacant commercial unit in the east of the site which is arranged over ground and first floor levels. A car park is present in the centre of the site and three commercial units are located in the west of the site, each arranged over ground and first floor levels.
- 4.3 Vehicular access to the site is from Northfield Road to the north of the site. Pedestrian access is available from both Caversham Road to the east of the site and Northfield Road.
- 4.4 The existing site is occupied 58% by building footprint and 42% by hardstanding.

Surrounding Land Uses

- 4.5 The site is located within a mixed commercial and residential setting. To the north, east and south of the site there are retail and commercial units. Residential properties are located to the east of the site.
- 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 topographic survey was undertaken by ASP in February 2019. This indicates that there is limited topographic variation within the site, as levels vary throughout the site between 37.82m AOD and

38.16m AOD. Northfield Road to the north of the site is indicated to be at an elevation of approximately 38.18m AOD and to slope down in a south easterly direction towards Caversham Road. Caversham Road immediately east of the site is indicated to be at an elevation of approximately 37.93m AOD. The topographic survey is located in Appendix C.

5 PROPOSED DEVELOPMENT

- 5.1 It is proposed to demolish the existing building in the west of the site and redevelop this area to provide a seven-storey building comprising a ground floor retail unit and 44 residential flats located over the upper six floor levels. Ancillary features for the residential use will additionally be located at ground floor level. Car parking will be provided in the centre of the site. Development plans are shown in Appendix D.
- 5.2 The existing three commercial units in the west of the site will be retained, with no alterations proposed, and therefore do not form part of the proposed works.
- 5.3 Vehicular access to the site will remain from Northfield Road. Pedestrian access to the retail unit will be from Caversham Road and access to the residential units will be from Northfield Road.
- 5.4 It is proposed to cantilever part of the building and therefore the floor space from first through sixth floor levels will be greater than the ground floor footprint.
- 5.5 Following redevelopment, the site will be occupied 44% by building footprint, 55% by hardstanding and 1% by soft landscaping.
- 5.6 The proposed residential use of the site is classified as 'more vulnerable' within the PPG and the proposed retail use is classified as 'less vulnerable'.
- 5.7 At this stage, an indicative drainage layout has been designed for the site, see Section 10. It is anticipated that surface water runoff will pass to the existing surface water sewer. Thames Water and the LLFA have both provisionally agreed to a discharge rate of 2 l/s.
- 5.8 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

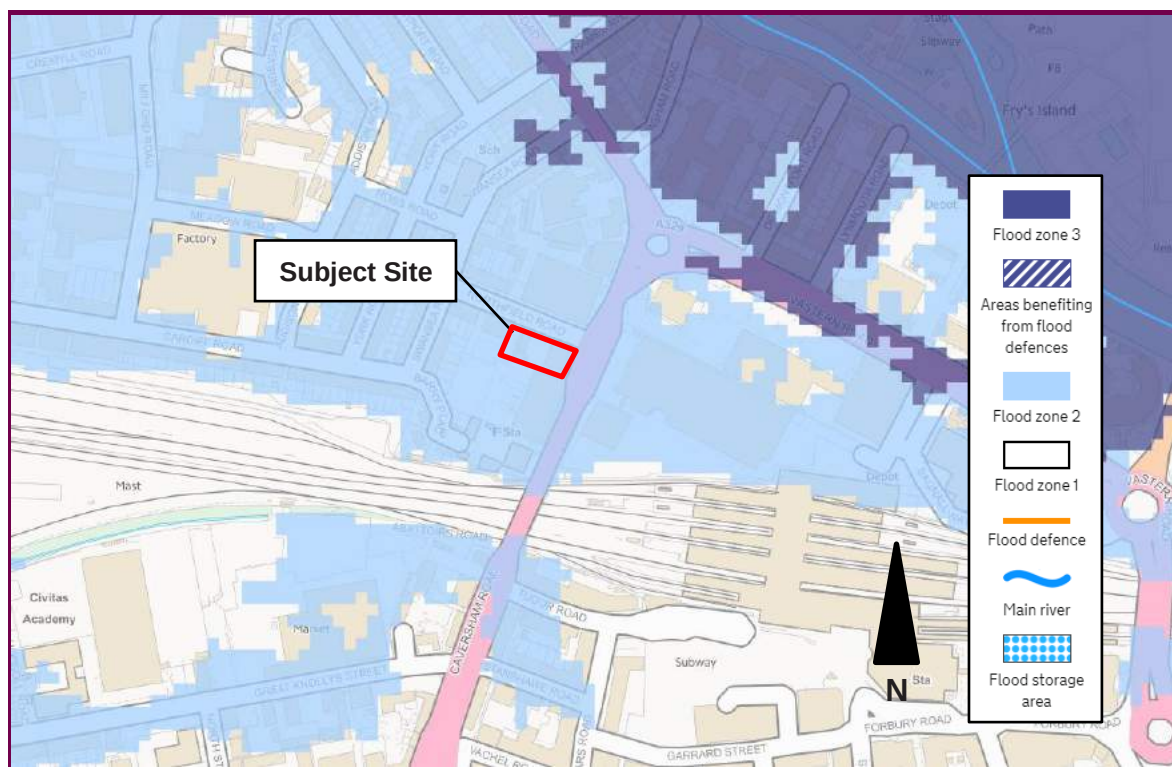
Nearby Watercourses

- 6.1 Reference to OS Mapping indicates that the nearest surface water feature is the River Thames, 295m northeast of the site. It flows in a south-easterly direction in the vicinity of the site.
- 6.2 A surface water drain is additionally located 450m northwest of the site. It is not clear if this is hydraulically connected to the River Thames.
- 6.3 A branch of the River Kennet is located 840m southeast of the site. The River Kennet flows in a north-easterly direction towards its confluence with the River Thames 1.8km east of the site.
- 6.4 No significant artificial watercourses / features (e.g. canals, reservoirs) have been identified within 1km of the site.

Fluvial / Tidal Flood Risk Classification

EA data

- 6.5 The EA Flood Map for Planning, which is available online, indicates that the site is located within Flood Zone 2, whereby the annual probability of flooding from fluvial sources is classified as greater than 1 in 1000 but less than 1 in 100. The EA Flood Map for Planning is provided in Figure 2.



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Figure 2. EA Flood Map for Planning

- 6.6 The EA were contacted to obtain further information regarding the fluvial flood risk at the site. A summary of key information from their response is provided below and the full response is provided in Appendix A.
 - There are no flood defences present in the vicinity of the site.

- The site is not recorded to have been historically affected by fluvial flooding. It is noted that flooding associated with the 1947 event is recorded to have occurred along Caversham Road to the south of the site and this flood extent is not hydraulically connected to the Thames to the north or the Kennet to the south. Flooding was also recorded to have occurred further north and west of the site during this event.
- Modelled flood data was provided from the River Thames (Sandford to Mapledurham) study completed in 2018. The site is shown to be outside of the modelled flood extent for all events up to and including the 1 in 100 year event. The site is shown to be affected by the 1 in 100 year plus 25% climate change event. Both in-channel flood levels and floodplain levels were provided. The node point 'floodplain 1' is on the site itself and so modelled levels have been included in Table 1 below.

Table 1. Modelled flood levels (CC = climate change)

Node	1 in 100 + 25% CC	1 in 100 + 35% CC	1 in 100 + 70% CC	1 in 1000 year
Floodplain 1 (on-site)	38.29	38.35	38.55	38.49

Fluvial Hazard Mapping

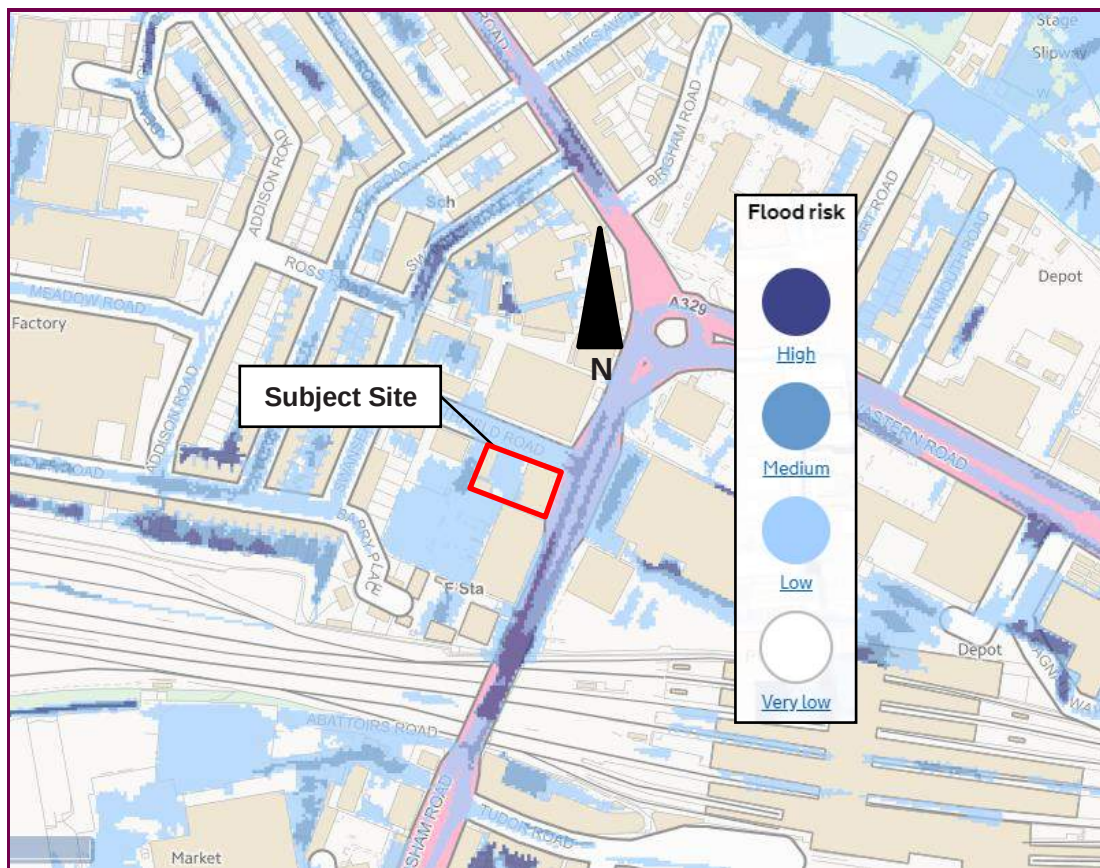
- 6.7 The EA were able to provide modelled flood extents and flood levels for scenarios which include their updated climate change allowances in accordance with their 2016 guidance. However, flood hazard mapping was provided only for a 1 in 100 year event and no mapping was provided for climate change scenarios.
- 6.8 In accordance with the EA's 2016 guidance, for a 'more vulnerable' development in Flood Zone 2, it is necessary to consider a 25% and 35% allowance for climate change on the existing 1 in 100 year flood event. RPS has obtained the EA's flood model and processed the model files to create the hazard mapping. The outputs from this are provided in Appendix E.
- 6.9 During a 1 in 100 year plus 25% climate change event the site is almost entirely at a 'hazard to some' flood hazard rating and Northfield Road and Caversham Roads are both at a 'hazard to some' rating in the vicinity of the site.
- 6.10 During a 1 in 100 year plus 35% climate change event the site is almost entirely at a 'hazard to some' flood hazard rating, with a very limited area in the west of the site at a 'hazard to most'. Northfield Road and Caversham Roads are both at a 'hazard to some' or 'hazard to most' rating in the vicinity of the site.

EA Flood Warning Area

- 6.11 The EA defines a Flood Warning Area as "geographical areas where we expect flooding to occur and where we provide a Flood Warning Service. They generally contain properties that are expected to flood from rivers or the sea and in some areas, from groundwater."
- 6.12 The site is located in the Flood Warning Area "River Thames from Mapledurham to Sonning, including Mapledurham, Reading, Caversham, Playhatch and Sonning".

Surface Water Flood Risk Classification

- 6.13 The EA's updated Flood Map for Surface Water, which is available online, indicates that the site is partially at a 'very low' risk of surface water flooding. This corresponds with an annual probability of flooding that is less than 1 in 1000. The central car parking area is indicated to be at a 'low' risk of surface water flooding, whereby the annual probability of surface water flooding is greater than 1 in 1000 but less than 1 in 100. The updated Flood Map for Surface Water is presented in Figure 3.



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Figure 3. Updated Flood Map for Surface Water

Reservoir Flood Risk Classification

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

Local Authority Flood Risk Assessment

- 6.15 The RBC SFRA was published in June 2017. It provides an overview of flood risk from various sources within the borough. Information relevant to this assessment is summarised below:

- The site is located within the catchment of the River Thames.
- The site is located on a 'major aquifer high permeability' and is thus considered to be of elevated vulnerability.
- The site is not recorded to have been affected by historic flooding from fluvial, drainage or 'other' sources. Fluvial flooding was recorded to have occurred in the wider area in March 1947, November 1974, August 1977, December 2000, January 2003, July 2007, November 2012 or winter 2013/14.
- No groundwater flood events were recorded to have occurred at the site. The nearest such event occurred 160m north of the site. This occurred in the winters of 2000-2001 and 2002-2003.
- No road flooding was recorded to have occurred by RBC on Caversham Road in the vicinity of the site.

- The site is not located within the modelled reservoir flood extent if a failure of Whiteknights Lake were to occur. The Lake is located in the River Kennet catchment and is downstream of the site.
- The site is located within a 1km square area of which between 25% and 50% is considered to be susceptible to groundwater flooding.
- 21 to 50 sewer flooding incidents were recorded to have occurred in the postcode area of the site, as of February 2016.
- Several ordinary watercourses within the borough have been culverted for significant lengths into the Thames Water sewer system during historic urban expansion. The SFRA noted that some flood risk may be present in these areas associated with the former valley that contributed to the watercourse and the potential for blockage.

7 HYDROGEOLOGICAL SETTING

- 7.1 British Geological Survey (BGS) online mapping (1:50,000 scale) indicates that the site is situated on the Langley Silt Member, comprising clay and silt. This is underlain by the Seaford and Newhaven Chalk Formations.
- 7.2 A BGS borehole log located 80m south of the site (reference SU77SW892) reported that groundwater was struck at 2.55m below ground level, with standing water recorded at 2.50m bgl after 30 minutes. The log reported Made Ground and Clay elements to a depth of 1.7m bgl, which was underlain by a clayey Alluvium to a depth of 2.6m bgl, the base of the pit.
- 7.3 The soils are described as 'freely draining slightly acid loamy soils' by the National Soils Research Institute.
- 7.4 According to the EA's Aquifer Designation Mapping, the Langley Silt Member at the surface is classified as an Unproductive Stratum. These formations have a low permeability and have negligible significance for water supply or base flow. This is underlain by a Principal Aquifer relating to the Chalk Formations. These formations provide a high level of water storage and may support water supply and / or river base flow on a strategic scale.
- 7.5 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 F, indicates that the site is likely served by a surface water beneath Northfield Road. The surface water sewer is of 300mm diameter and flows in an easterly direction. This then connects into a surface water sewer beneath Caversham Road and flows in a north easterly direction, likely towards the River Thames.
- 8.2 There are two sections of on-site adopted foul sewer that connect into Northfield Road. The foul sewer in Northfield Road is inferred to also flow in an easterly direction, towards a 300mm diameter sewer beneath Caversham Road that flows south westerly.
- 8.3 A culverted watercourse is indicated to be present beneath Caversham Road 25m to the southeast of the site. The culvert has a diameter of 600mm and flows in a north easterly direction through the retail park.
- 8.4 Manhole cover levels and invert levels (where provided) are given in Table 2.

Table 2. Manhole level details

Manhole Reference	Location	Manhole Cover Level (mAOD)	Manhole Invert Level (mAOD)	Invert Depth (m)
2052 F	Junction Caversham Rd and Northfield Road (northeast)	N/A	N/A	N/A
2051 S	Caversham Road (east)	N/A	N/A	N/A
201A F	Caversham Road (east)	N/A	N/A	N/A
2955 W	Caversham Road (south)	38.25	36.07	2.18

F = foul sewer, S = surface water sewer, W = watercourse

- 8.5 Thames Water have advised that they have no records of flooding at the site as a result of surcharging sewers.
- 8.6 Reference to water network plans provided by Thames Water indicates that the site is likely served by 6-inch (approximately 15.24cm) water mains beneath Northfield Road and Caversham Road.

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 2. The annual probability of fluvial flooding is classified as greater than 1 in 1000 but less than 1 in 100 in the absence of any defences.
- 9.3 The EA have confirmed that there are no flood defences in the vicinity of the site and that they have no records of historic flooding at the site. The SFRA did not record historic fluvial flooding at the site, despite Reading having been impacted by flooding multiple times over the last 50 years.
- 9.4 The site would not be affected by a current 1 in 100 year flood event from the River Thames and would only be affected by an event more extreme than this, or when an allowance for climate change is applied.
- 9.5 In accordance with the EA's 2016 climate change guidance, a 25% and 35% allowance for climate change has been applied. Modelled flood data provided by the EA indicates that the site would be affected by flooding during both events. The on-site flood level would be 38.29m AOD when a 25% climate change allowance is considered, correlating to a maximum flood depth of 0.47m. However, flood depths would generally be approximately 0.3m. When a 35% climate change allowance is applied the flood level increases to 38.35m AOD, correlating to a maximum flood depth of 0.53m.
- 9.6 A culverted watercourse was identified on Thames Water sewer mapping beneath Caversham Road to the south and then flowing beneath the retail park by Reading Station. The SFRA notes that several ordinary watercourses in the borough have been incorporated into the sewer system during the urban expansion of Reading. Therefore, it is unlikely that this watercourse presents a conventional fluvial flood risk. The SFRA further notes that the risks associated with such culverts are likely related to contributing valley topography or culvert blockage. However, should overland flow occur, water is likely to flow in a southerly direction along Caversham Road away from the site and therefore neither of these are considered to present a high risk of flooding to the site.
- 9.7 A sequential approach has been adopted within the site and the 'more vulnerable' residential accommodation has been located at first floor level and above, significantly above the modelled flood level.
- 9.8 It is acknowledged that in order to comply with the Equality Act and achieve access to the retail unit for all, it would not be possible to elevate the ground floor level by c. 0.5m in order to be above the climate change flood level. In addition, the site is not in the current 100 year floodplain and a retail unit has a lifespan of 60 years, (for which the Central allowance for CC of 15% would apply, and therefore the predicted flood depth would be reduced to less than 300mm), therefore it is disproportionate to significantly elevate ground floor levels.
- 9.9 It is recommended that flood resilience and resistance techniques are incorporated into the ground floor level up to 38.35m AOD, where appropriate, to minimise the impact of a fluvial flood event and increase the speed at which the building would recover, should internal flooding occur.
- 9.10 A route of dry access and egress is available to the south of the site during the 1 in 100 year fluvial flood event. Hazard mapping provided in Appendix E illustrates that there is no route of safe access and egress – with a 'very low' flood hazard - available from the site to an area wholly outside of the floodplain during a 1 in 100 year plus climate change event.
- 9.11 The location of all residential units on the upper floors of the building results in each unit comprising safe refuge should flooding occur. It is recommended that a Flood Management Plan is prepared to detail how residents would sign up to receive flood warnings, how to be prepared for such an

event occurring and the action to take upon receipt of a flood warning. A similar plan should also be prepared for the retail unit, which may form part of a business continuity plan.

- 9.12 It is noted that the site is located less than 400m (5 minutes walk) from the edge of the floodplain and therefore it is likely that users of the commercial unit could safely escape prior to the onset of flooding. In addition, as there are no areas of 'hazard to all' along the route to Flood Zone 1, the emergency services should be able to access the site, if required.
- 9.13 The existing building in the east of the site has a footprint of 708m² and the new building, plus associated structural columns and raised planters have a combined area of 553m². Therefore, there will be a net reduction in built form within the 1 in 100 year plus climate change extent. There should be no elevation of external site levels as part of the proposed development and on this basis the provision of floodplain compensation is not required.
- 9.14 The PPG details the suitability of different land uses within each flood zone. The proposed land uses are classified as 'more vulnerable' and 'less vulnerable' and such uses are generally considered appropriate within Flood Zone 2.

Proposed Mitigation

- 9.15 All residential accommodation will be located on the first-floor level and above, significantly above the modelled flood level.
- 9.16 Flood resistance / resilience techniques to be incorporated into the ground floor level up to 38.35m AOD, where feasible. This could include the elevation of electrical sockets and main utility components above this level, flood resistant airbrick covers up to this level, use of solid concrete floors and incorporation of non-return valves in toilets. The use of flood barriers for doorways could also be considered, however, it is acknowledged that the site would only be impacted by fluvial flooding during an extreme event or when an allowance for climate change is made.
- 9.17 All residents and site managers should sign up to the EA's free Flood Warning service. It is also recommended that a Flood Management Plan is prepared to educate site occupants on the risk of flooding at the site and the actions to be taken upon receipt of a flood warning.
- 9.18 There should be no elevation of external site levels as part of the proposed development.

Flooding from Sewers

- 9.19 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 foul and surface water sewers beneath Caversham Road and Northfield Road (detailed in Section 8).
- 9.20 Whilst 21 to 50 sewer flooding incidents were recorded within the postcode area of the site in the SFRA, Thames Water have advised that they have no records of flooding at the site from surcharging sewers.
- 9.21 In the event of sewer surcharging, water would likely flow in an easterly direction along Northfield Road towards Caversham Road and is unlikely to pond at the site itself.
- 9.22 The proposed residential accommodation is located on the upper floors of the building and will therefore be afforded a significant degree of protection against sewer surcharging in the vicinity of the site.
- 9.23 Thames Water have advised that they have capacity to take the foul discharge from the site and that they are content with a surface water discharge rate of 2 l/s to their network.

Proposed Mitigation

- 9.24 It is recommended that the finished ground floor level of both the residential ancillary uses and the retail unit are elevated by 150mm, where feasible, to help mitigate against the residual risk of sewer surcharging.

Surface Water Flooding (Overland Flow)

- 9.25 This can occur during intense rainfall events, when water cannot soak into the ground or enter drainage systems.
- 9.26 The site is identified on EA mapping to be at a 'very low' or 'low' risk of surface water flooding and would therefore not be affected by surface water flooding during a 1 in 100 year rainfall event.
- 9.27 Should overland flow occur, water is likely to flow in an easterly direction along Northfield Road or a southerly direction along Caversham Road, following local topography, rather than ponding at the subject site.
- 9.28 No surface water or drainage flooding incidents have been recorded in the SFRA at the subject site or on the roads in the immediate vicinity.
- 9.29 Surface water flooding from on-site sources is considered in Section 10 of this report.

Proposed Mitigation

- 9.30 It is recommended that the finished ground floor level of both the residential ancillary uses and the retail unit are elevated by 150mm, where feasible, to help mitigate against the residual surface water flood risk.

Groundwater Flooding

- 9.31 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 Langley Silt Member and subsequently the Chalk Formations, which are considered to be a 'major aquifer high permeability'. A nearby BGS borehole log indicates a groundwater resting level of 2.5m bgl.
- 9.32 Whilst the SFRA identifies that the site is located within a 1km grid square that has a slightly elevated susceptibility to groundwater flooding, no groundwater flood events were recorded to have occurred at the site or within 150m of the site.
- 9.33 There are no basement levels in the proposed scheme and therefore the vulnerability to groundwater flooding is considered to be reduced.

Proposed Mitigation

- 9.34 No mitigation is required.

Other Sources

- 9.35 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.
- 9.36 In the event of a burst water main, water would likely flow in an easterly direction along Northfield Road or a southerly direction along Caversham Road rather than ponding at the site itself.
- 9.37 The risk of flooding associated with reservoirs, canals and other artificial structures is considered to be low given the absence of any such structures in the site vicinity and as neither SFRA nor EA mapping identifies the site to be at risk of reservoir flooding.

Proposed Mitigation

- 9.38 It is recommended that the finished ground floor level of both the residential ancillary uses and the retail unit are elevated by 150mm, where feasible, to help mitigate against the residual risk from burst water mains.

Event Exceedance and Residual Risk

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

10 SURFACE WATER MANAGEMENT

Introduction

- 10.1 The proposed development comprises the demolition of an existing building and replacement with a reduced building footprint. Therefore, there will be no increase in impermeable area at the site and the incorporation of several planted areas will enable an increase in landscaping of 48m².
- 10.2 Generally residential development is considered to have a design life of 100 years and the retail use is considered to have a design life of 60 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 Under the PPG, SuDS should be provided for major developments unless demonstrated to be inappropriate. The non-statutory technical standards for SuDS (Defra, March 2015) states that the peak runoff rate from the development for the 1 in 1 year and 1 in 100 year rainfall event should not exceed the equivalent greenfield rate for greenfield developments, or the pre-development rate for previously developed sites. Where reasonably practicable, the runoff volume from the development for the 1 in 100 year, 6 hour rainfall event should be constrained to the greenfield volume for greenfield developments, and the pre-development volume for previously developed sites.
- 10.4 Consultation with RBC and Thames Water have confirmed agreement of a discharge rate of 2 l/s from the site. RBC advised that they would want attenuation to be provided for the entire red line boundary and not just the new build elements.

Surface Water Runoff Rates

Brownfield Runoff Rate

- 10.5 The proposed development is on a previously developed site and is therefore considered brownfield land. The pre-development runoff rates for proposed impermeable areas have been calculated using the Wallingford Modified Rational Method. The pre developments rates for a 1 year storm are presented in Table 3 below with a full report included as Appendix G.

Table 3. Pre-development surface water runoff rates

Return Period (years)	Existing Runoff Rate (l/s)
1 in 1	10.6
1 in 30	34.8
1 in 100	44.4
1 in 100 + 40% CC*	62.1

*CC = climate change allowance

Equivalent Greenfield Runoff Rate

- 10.6 The greenfield runoff rate for the proposed impermeable areas have been calculated using the Interim Code of Practice for Sustainable Drainage Systems (ICP SuDS) Method. The equivalent greenfield rates are presented in Table 4 below. ICP SuDS calculations are included as Appendix H.

Table 4. Greenfield equivalent surface water runoff rates

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

Q_{BAR} = mean annual flood low

Proposed Runoff Discharge Rates

- 10.7 Given the Q_{BAR} rate is 0.1 l/s, surface water runoff is proposed to be restricted to 2 l/s, as the lowest practical minimum rate to achieve a self-cleansing system. In order to achieve this restriction 81.5m³ of attenuation would be provided for all events up to and including the 1 in 100 year plus 40% climate change event.
- 10.8 Achieving a discharge rate of 2 l/s will provide a 81% betterment on the existing brownfield runoff rate according to Table 3 and also complies with the requirement to provide long term storage.

Consideration of Drainage Hierarchy

- 10.9 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.
- 10.10 The drainage hierarchy has been considered as follows.

Infiltration

- 10.11 Reference to BGS mapping indicates that the site is underlain by the Langley Silt Member and subsequently the Seaford and Newhaven Chalk Formations. Whilst the chalk is likely to be permeable, the Langley Silt Member is an Unproductive Stratum and is of low permeability. On this basis, the use of infiltration SuDS techniques is not considered to be feasible at the site.

To a Surface Water Body

- 10.12 There are no surface watercourses located in close proximity to the site. Whilst a culverted watercourse is located to the southwest of the site, discharge to this is not considered to be appropriate as the capacity and condition of the culvert are unknown and therefore there would be the potential to increase flood risk.

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

- 10.13 It is proposed to discharge to a surface water sewer located to the north of the site beneath Northfield Road. Thames Water have advised that they have capacity within the network to take flow from the proposed development, subject to such flows being limited to 2 l/s.

To a Combined Sewer

- 10.14 The drainage hierarchy has been followed and discharge to a surface water sewer has been proposed, therefore discharge to a combined sewer is not necessary.

Consideration of Sustainable Drainage Systems

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

Infiltration SuDS Features

- 10.16 Reference to BGS mapping indicates the site is underlain by Langley Silt Member and subsequently Chalk. Given the reported superficial geology beneath the site, it is considered that soakaways or other infiltration based SuDS techniques are unlikely to provide a feasible method for the disposal of surface water runoff from the site.

Rainwater Harvesting

- 10.17 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. Therefore, rainwater harvesting has not been proposed at the site as part of the attenuation strategy.

Green Roofs

- 10.18 It is not proposed to include green roofs as part of the proposed development. However, planters are proposed on the roof as part of amenity areas. These planters will help provide limited water storage in the soil substrate and reduce runoff through evapotranspiration.

Swales, Detention Basins and Ponds

- 10.19 Due to the limited size of the site and the retention of the existing office buildings in the west of the site the incorporation of open storage features is not feasible at the site.

Permeable / Porous Paving

- 10.20 It is proposed to incorporate permeable paving in the external ground level areas at the site, this will receive, treat and help attenuate flows from the roof of the proposed building and also the car park area. A minimum area of 170m² would be incorporated.
- 10.21 The gravel subbase would provide water quality benefits and storage would be provided in the subbase prior to connecting into the underground attenuation tank.

Modular Underground Attenuation Tanks

- 10.22 In addition to the aforementioned permeable paving, it is proposed to include underground attenuation crates at the site. These will provide a significant volume of attenuation prior to discharge to the receiving sewer.

Conceptual Surface Water Drainage Strategy

- 10.23 It has been evaluated that 81.5m³ of attenuation will be required in order to achieve a discharge rate of 2 l/s during a 1 in 100 year plus 40% climate change event. The Micro-Drainage calculations used to calculate this requirement are provided in Appendix H.
- 10.24 The first stage of the proposed surface water drainage strategy is the permeable paving which will be incorporated across the car parking and access road area. As a conservative estimate, the permeable paving has been shown only on the area which will receive direct rainfall and that is overshadowed by the cantilevered building. However, there are opportunities to increase the

permeable paving area beneath the building at ground level. The use of 170m² of pavement will provide a minimum attenuation volume of 15.3m³ based on a minimum depth of 0.3m and a porosity of 30%.

- 10.25 The attenuation provided by the pavement will then be connected to underground attenuation crates located beneath the parking area. With a minimum surface area of 70m², depth of 1.05m and porosity of 95%, they can provide at least 69.825m³ of attenuation. Therefore, between the crates and the permeable pavement the required attenuation volume will be exceeded.
- 10.26 The outflow from the attenuation crates will be restricted to a rate of 2 l/s by a Hydrobrake or similar flow control device prior to connecting to the Thames Water surface water sewer beneath Northfield Road.
- 10.27 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 underlying geology. However, storage will be provided within the permeable paving and 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 nearby surface water sewer which is also in accordance with the Hierarchy. Thames Water has initially accepted our proposal to attenuate surface water on site and discharge to the surface water sewer system at a rate of 2 l/s.
- 10.28 Overall, the proposed development will meet local and national planning policy requirements through incorporating permeable paving and underground attenuation crates to achieve a discharge rate of 2 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

- 10.29 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 I. A detailed maintenance programme will be required as part of the detailed drainage design for the site.

Event Exceedance

- 10.30 The proposed indicative surface water drainage concept provides storage up to the 1 in 100 year plus climate change event. In an event exceeding this magnitude, 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.
- 10.31 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.

11 SEQUENTIAL TEST AND EXCEPTION TEST

11.1 The Sequential and Exception Tests have been addressed specifically for the residential use in a separate Flood Risk Sequential Test document with reference HLEF74507/001R.

11.2 Both Tests have been considered in relation to the proposed retail unit below.

Sequential Test

11.3 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.

11.4 Given that the subject site has not been allocated as one of the Council's proposed future development sites, it has not been specifically assessed within the SFRA. Therefore the Sequential Test is based on the EA Flood Zones and information contained within the SFRA.

11.5 The site is located within Flood Zone 2 and comprises an existing commercial unit. Therefore, the redevelopment of the site and re-provision of a retail unit will not result in an increase in the vulnerability use class at the site, nor will it increase the number of people within the floodplain associated with this use. Flood resilience and resistance techniques will be incorporated into the ground floor level to reduce the impact of fluvial flooding, should it occur. No significant risks have been identified in relation to flooding from non-fluvial sources. Therefore, the proposed retail unit is considered to pass the Sequential Test

The Exception Test

11.6 According to Table 3 of the PPG to the NPPF, 'less vulnerable' developments are considered appropriate within Flood Zone 2 without the requirement to apply the Exception Test. Therefore, application of the Exception Test is not required for the proposed development.

12 BREEAM POL 03

- 12.1 The proposed retail unit is to be assessed under BREEAM New Construction 2018 to determine the number of credits it achieves for Pol 03 Flood and surface water management.

Flood Resilience

- 12.2 One credit is available for sites identified to be at a 'medium or high flood risk' where the following has been demonstrated:
- 12.3 *'A site-specific FRA confirms the development is in a flood zone that is defined as having a medium or high annual probability of flooding and is not in a functional floodplain. The FRA must take all current and future sources of flooding into consideration [...]*
- 12.4 *To increase the resilience and resistance of the development to flooding, one of the following must be achieved:*
- a) *The ground level of the building and access to both the building and the site, are designed (or zoned) so they are at least 600 mm above the design flood level of the site's flood zone).*
 - b) *The final design of the building and the wider site reflects the recommendations made by an appropriate consultant in accordance with the hierarchy approach outlined in section 5 of BS 8533:2017.*
- 12.5 This FRA has identified that the development is located within the EA's Flood Zone 2, whereby the annual probability of fluvial flooding is considered to be medium. Current flood risk has been considered in relation to flooding from fluvial tidal, surface water, groundwater, sewers, reservoirs, canals and other artificial sources. Future flood risk has been considered in relation to fluvial flooding only as climate change data was not available for any other source of flooding. The site is located within the 1 in 100 year plus climate change fluvial flood extent. Therefore, the first part of the BREEAM requirements is considered to be met.
- 12.6 The ground floor level of the retail unit is not proposed to be elevated 600mm above the design flood level and therefore the credit cannot be achieved under part a).
- 12.7 Recommendations have been made for flood resilience techniques to be included for the retail unit. Upon completion of this development, assessment of whether one credit can be achieved under part b) above can be undertaken.

Surface Water Run-off

- 12.8 Two further credits are available for surface water run-off schemes. A bespoke surface water drainage scheme has been designed for the site, which takes into account the constraints posed by the low permeability geology, the retained buildings in the west of the site and the limited size of the site. Therefore, the pre-requisite for the surface water run-off credits is met.

Surface Water Run-off Rate

- 12.9 In order to achieve one credit for the surface water run-off rate, it must be demonstrated that *'the peak rate of run-off from the site to the watercourses (natural or municipal) shows a 30% improvement for the developed site compared with the pre-developed site. This should comply at the 1-year and 100-year return period events.'* The pre-development runoff rate is 10.6 l/s for the 15 minute 1 year storm event, as provided in Appendix G. The proposed runoff rate from the site is 2 l/s for all events up to and including a 1 in 100 year plus 40% climate change event, therefore an 81% improvement has been made in comparison to a pre-development 1 year event and a 97%

reduction compared to the pre-development 1 in 100 year plus 40% climate change runoff rate of 62.1 l/s.

- 12.10 A maintenance plan has been included in Appendix J and confirmation has been provided by the client that the drainage system will be maintained for the lifetime of the development, see Appendix K.
- 12.11 The drainage system has been designed to attenuate for the 1 in 100 year plus 40% climate change event, in accordance with the latest climate change allowance guidance issued by the EA.
- 12.12 On the basis of the above, it is considered that one credit can be achieved for the surface water run-off rate.

Surface Water Run-off Volume

- 12.13 The drainage system has been designed to attenuate water for the 1 in 100 year plus 40% climate change rainfall event – an extreme rainfall event – therefore flooding of property would not occur in the event of local drainage system failure.
- 12.14 It is not possible to reduce surface water run-off volumes post development as the use of infiltration SuDS techniques is not appropriate given the presence of underlying contamination and the low permeability geology relating to the Langley Silt Member and London Clay Formation.
- 12.15 On this basis, to achieve this credit, it must be demonstrated that *'the post-development peak rate of run-off is reduced to the limiting discharge. The limiting discharge is defined as the highest flow rate from the following options:*
 - a) *The pre-development one-year peak flow rate*
 - b) *The mean annual flow rate (Qbar)*
 - c) *2L/s/ha.*
- 12.16 *For the one-year peak flow rate, the one-year return period event criterion applies.'*
- 12.17 The pre-development one-year peak flow rate is 10.6 l/s and the proposed discharge rate for the 1 in 100 year plus 40% climate change event is 2 l/s. Therefore, a very significant reduction below the 'limiting discharge' is achieved post-development.
- 12.18 Again, the relevant information regarding ownership and maintenance of the drainage system has been provided in Appendices J and K. Further information regarding SuDS maintenance will be provided at detailed design stage. The drainage system has been designed to the 100 year return period event include a 40% allowance for climate change.
- 12.19 As such, it is considered that one credit can be awarded for the surface water run-off volume.

Summary

- 12.20 Two credits for surface water run-off can be awarded under Pol 03 of BREEAM New Construction 2018. One credit for flood resilience may also be achievable following assessment post-construction.

13 SUMMARY AND CONCLUSIONS

- 13.1 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 following consultation with the LLFA.
- 13.2 The potential flood risks to the site, and the measures proposed to mitigate the identified risks, are summarised in Table 5.

Table 5. Proposed mitigation

Source of Flooding	Identified Risk			Mitigation Proposed	Residual Risk		
	L	M	H		L	M	H
Fluvial		✓		- All residential accommodation will be located on the first-floor level and above. - Flood resistance / resilience techniques to be incorporated into the ground floor level up to 38.35m AOD, where feasible. - All residents and site managers should sign up to the EA's free Flood Warning service. - Production of a Flood Management Plan - No elevation of external site levels.	✓		
Tidal	✓			Not applicable.	✓		
Sewers	✓			Recommended elevation of ground floor level by 150mm.	✓		
Surface Water	✓			Recommended elevation of ground floor level by 150mm.	✓		
Groundwater	✓			None required.	✓		
Other Sources (e.g. reservoirs, water mains)	✓			Recommended elevation of ground floor level by 150mm.	✓		

- 13.3 The site is located within Flood Zone 2 associated with fluvial flooding from the River Thames. When a climate change allowance is applied the site would be located within the 1 in 100 year flood extent. Therefore, all residential accommodation will be located at first floor level and above, significantly above the modelled fluvial flood level. Flood resistance and resilience techniques are recommended to be incorporated at ground floor level, up to the 1 in 100 year plus 35% climate change flood level of 38.35m AOD. This will help minimise the damage caused and reduce the time in which the retail unit cannot operate, should flooding occur.
- 13.4 Whilst safe access and egress is not available during a 1 in 100 year plus climate change event, it is recommended that site management and residents sign up to receive free flood warnings from the EA. The residential units themselves comprise safe refuge and it is considered that adequate warning will be provided for the retail unit to be evacuated, especially given the proximity of an area wholly outside of the floodplain. It is recommended that a Flood Management Plan is prepared to detail the actions to be taken before, during and after a potential flood event.
- 13.5 No significant risks were identified in relation to flooding from non-fluvial sources. In line with Building Regulations, it is recommended that the ground floor level is elevated 150mm above

surrounding ground levels to help mitigate the increase of floodwater from other sources, should an extreme event occur.

- 13.6 It is proposed to incorporate permeable paving and underground attenuation crates to reduce the surface water discharge rate to 2 l/s. The permeable paving will additionally provide water quality benefits, prior to discharge to the Thames Water surface water sewer.
- 13.7 Overall, it has been demonstrated that the development would be safe, without increasing flood risk elsewhere, and that a positive reduction in flood risk would be achieved through the inclusion of surface water attenuation techniques.
- 13.8 It has been demonstrated that the retail unit can achieve two surface water runoff credits under Pol 03 of BREEAM 2018. One flood resilience credit may also be achievable, to be confirmed post construction.

APPENDICES

Appendix A

EA Detailed Flood Data

Product 4 (Detailed Flood Risk) for Site at Caversham Road, Reading RG1 8JA

Our Ref: THM118462

Product 4 is designed for developers where Flood Risk Standing Advice FRA (Flood Risk Assessment) Guidance Note 3 Applies. This is:

- i) "all applications in Flood Zone 3, other than non-domestic extensions less than 250 sq metres; and all domestic extensions", and
- ii) "all applications with a site area greater than 1 ha" in Flood Zone 2.

Product 4 includes the following information:

Ordnance Survey 1:25k colour raster base mapping;
Flood Zone 2 and Flood Zone 3;
Relevant model node locations and unique identifiers (for cross referencing to the water levels, depths and flows table);
Model extents showing *defended* scenarios;
FRA site boundary (where a suitable GIS layer is supplied);
Flood defence locations (where available/relevant) and unique identifiers; (supplied separately)
Flood Map areas benefiting from defences (where available/relevant);
Flood Map flood storage areas (where available/relevant);
Historic flood events outlines (where available/relevant, not the Historic Flood Map) and unique identifiers;
Statutory (Sealed) Main River (where available within map extents);

A table showing:

- i) Model node X/Y coordinate locations, unique identifiers, and levels and flows for *defended* scenarios.
- ii) Flood defence locations unique identifiers and attributes; (supplied separately)
- iii) Historic flood events outlines unique identifiers and attributes; and
- iv) Local flood history data (where available/relevant).

Please note:

If you will be carrying out computer modelling as part of your Flood Risk Assessment, please request our guidance which sets out the requirements and best practice for computer river modelling.

This information is based on that currently available as of the date of this letter. You may feel it is appropriate to contact our office at regular intervals, to check whether any amendments/ improvements have been made. Should you re-contact us after a period of time, please quote the above reference in order to help us deal with your query.

This information is provided subject to the enclosed notice which you should read.

This letter is not a Flood Risk Assessment. The information supplied can be used to form part of your Flood Risk Assessment. Further advice and guidance regarding Flood Risk Assessments can be found on our website at:

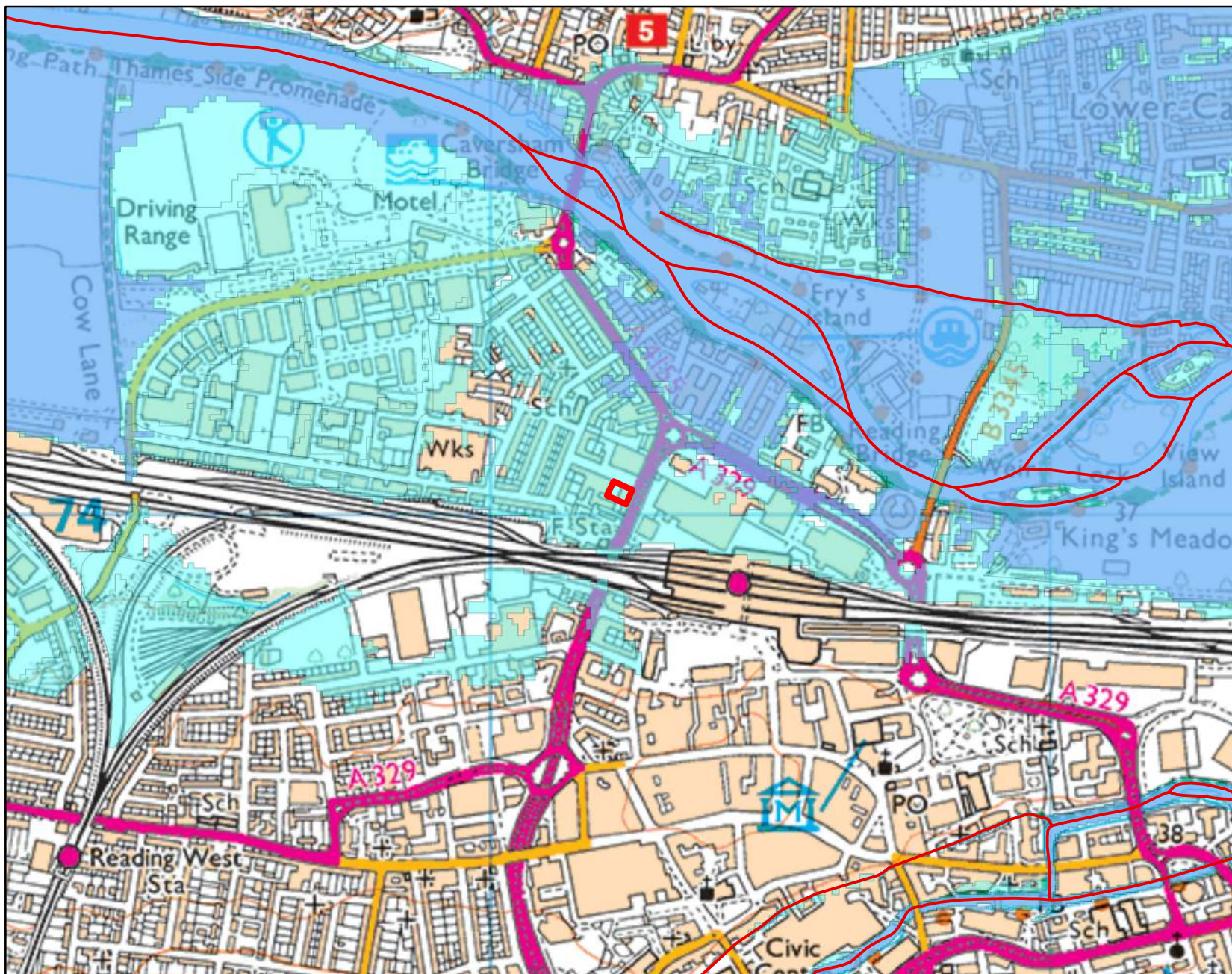
<https://www.gov.uk/guidance/flood-risk-assessment-local-planning-authorities>

If you would like advice from us regarding your development proposals you can complete our pre application enquiry form which can be found at:

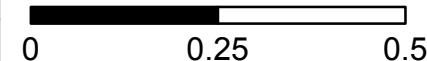
<https://www.gov.uk/government/publications/pre-planning-application-enquiry-form-preliminary-opinion>

Flood Map for Planning centred on RG1 8JA

Created on 28/03/19 REF:THM118462



Kilometres



Legend

- Main River
- Flood defences
- Areas benefiting from flood defences
- Flooding from rivers or sea (FZ3)
- Extent of extreme flood (FZ2)
- Flood Map - flood storage areas

Flooding from rivers or sea without defences (Flood Zone 3) shows the area that could be affected by flooding:

- from the sea with a 1 in 200 or greater chance of happening each year
- or from a river with a 1 in 100 or greater chance of happening each year.

The Extent of an extreme flood (Flood Zone 2) shows the extent of an extreme flood from rivers or the sea with up to a 1 in 1000 chance of occurring each year.

Defence information

Defence Location: No defences on Main River

Description: This location is not currently protected by any formal defences and we do not currently have any flood alleviation works planned for the area. However we continue to maintain certain watercourses and the schedule of these can be found on our internet pages.

Model information

THM118462

Model: Thames (Sandford to Mapledurham) 2018

Description: The information provided is from the Abingdon Flood Schemes mapping completed in June 2017. The previous model 1D model was updated to a 1D-2D model (Flood modeller-Tuflow). The updated model will also be used to assess downstream effects due to flood alleviation options in Oxford and Abingdon.

Model design runs:

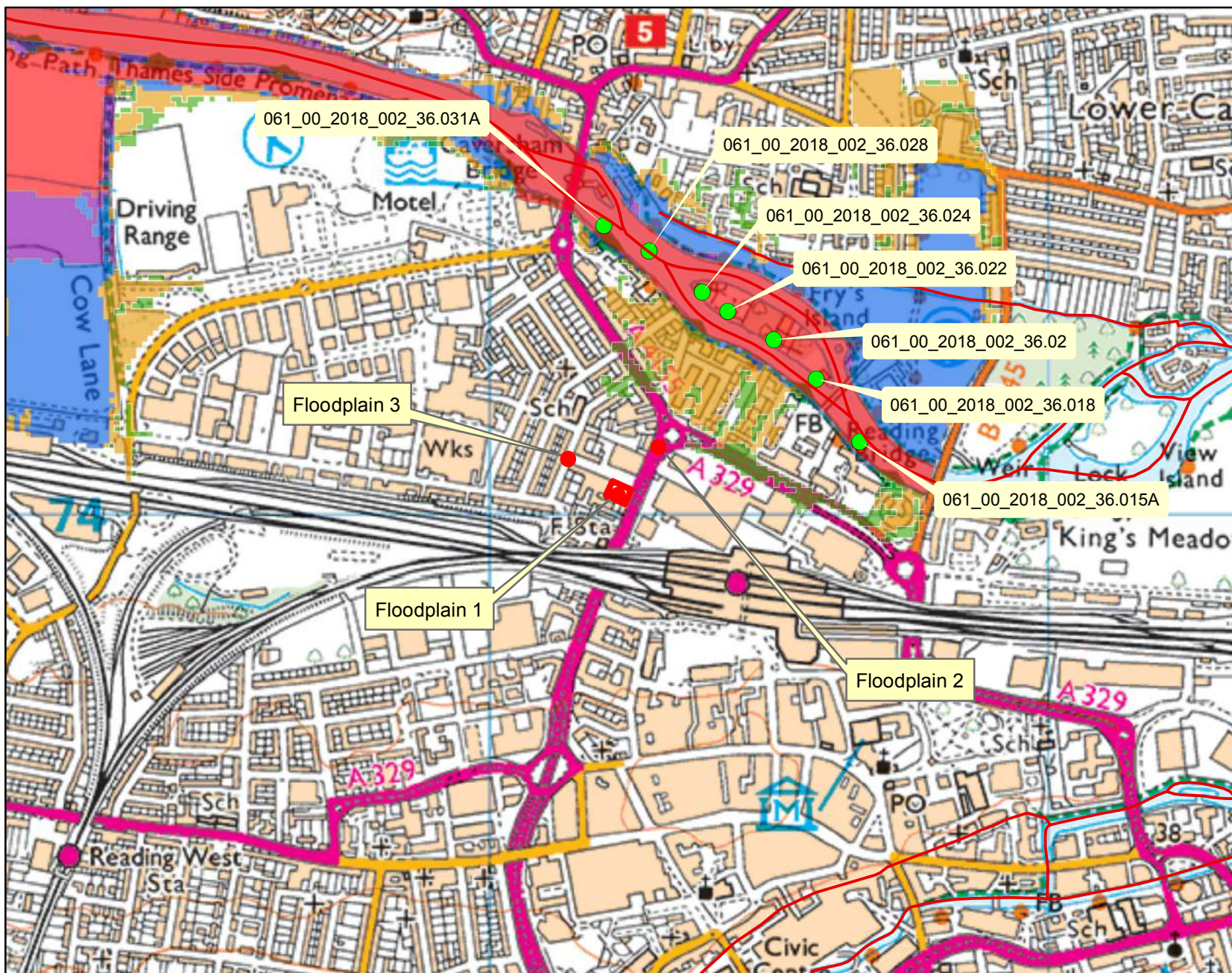
1 in 2/ 50% AEP; 1 in 5 / 20% AEP; 1 in 10/ 10% AEP; 1 in 20 / 5% AEP; 1 in 50/ 2% AEP; 1 in 75 / 1.3% AEP; 1 in 100 / 1% AEP, 1 in 100+25% / 1% + 25% AEP with climate change; 1 in 100+35% / 1% + 35% AEP with climate change; 1 in 100+70% / 1% + 70% AEP with climate change; 1 in 200/ 0.5% AEP and 1 in 1000 / 0.1% AEP.

Mapped outputs:

1 in 2/ 50% AEP; 1 in 5 / 20% AEP; 1 in 10/ 10% AEP; 1 in 20 / 5% AEP; 1 in 50/ 2% AEP; 1 in 75 / 1.3% AEP; 1 in 100 / 1% AEP, 1 in 100+25% / 1% + 25% AEP with climate change; 1 in 100+35% / 1% + 35% AEP with climate change; 1 in 100+70% / 1% + 70% AEP with climate change; 1 in 200/ 0.5% AEP and 1 in 1000 / 0.1% AEP.

Detailed FRA Map 1 centred on RG1 8JA

Created on 28/03/19 REF:THM118462



Legend

- Main River
- Model Nodes
- 50% AEP Flood Outline
- 20% AEP Flood Outline
- 5% AEP Flood Outline
- 1.33% AEP Flood Outline
- 1% AEP Flood Outline

AEP = Annual Exceedance Probability
The probability of a flood of a particular magnitude, or greater, occurring in any given year

Where available climate change extents have been calculated with an additional flow added to an AEP event. An example of how this is written is 1%+20% AEP.

Modelled in-channel flood flows and levels

THM118462

The modelled flood levels and flows for the closest most appropriate model node points for your site that are within the river channel are provided below:

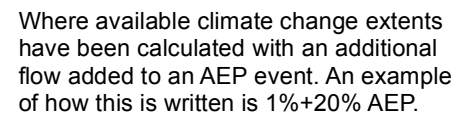
Node label	Model	Easting	Northing	Flood Levels (mAOD)							
				20% AEP	5% AEP	1% AEP	1% AEP (+20% increase in flows)	1% AEP (+25% increase in flows)	1% AEP (+35% increase in flows)	1% AEP (+70% increase in flows)	0.1% AEP
061_00_2018_002_36.015A	Thames (Sandford to Mapledurham) 2018	471664	174132	37.05	37.47	38.00	0.00	38.25	38.31	38.49	38.44
061_00_2018_002_36.018	Thames (Sandford to Mapledurham) 2018	471586	174244	37.08	37.50	38.02	0.00	38.26	38.31	38.47	38.43
061_00_2018_002_36.02	Thames (Sandford to Mapledurham) 2018	471511	174314	37.12	37.54	38.05	0.00	38.30	38.35	38.53	38.48
061_00_2018_002_36.022	Thames (Sandford to Mapledurham) 2018	471429	174366	37.14	37.56	38.06	0.00	38.30	38.36	38.53	38.48
061_00_2018_002_36.024	Thames (Sandford to Mapledurham) 2018	471382	174400	37.15	37.56	38.06	0.00	38.31	38.36	38.54	38.49
061_00_2018_002_36.028	Thames (Sandford to Mapledurham) 2018	471287	174474	37.18	37.59	38.09	0.00	38.33	38.39	38.57	38.51
061_00_2018_002_36.031A	Thames (Sandford to Mapledurham) 2018	471206	174519	37.20	37.61	38.10	0.00	38.34	38.40	38.58	38.53

Node label	Model	Easting	Northing	Flood Flows (m3/s)							
				20% AEP	5% AEP	1% AEP	1% AEP (+20% increase in flows)	1% AEP (+25% increase in flows)	1% AEP (+35% increase in flows)	1% AEP (+70% increase in flows)	0.1% AEP
061_00_2018_002_36.01	Thames (Sandford to Mapledurham) 2018	471664	174132	218.78	271.54	318.67	0.00	375.76	391.67	464.79	437.45
061_00_2018_002_36.01	Thames (Sandford to Mapledurham) 2018	471586	174244	218.77	265.74	327.36	0.00	403.00	423.32	514.97	481.80
061_00_2018_002_36.02	Thames (Sandford to Mapledurham) 2018	471511	174314	218.70	278.51	367.56	0.00	459.69	484.02	588.64	551.59
061_00_2018_002_36.02	Thames (Sandford to Mapledurham) 2018	471429	174366	218.78	283.01	379.65	0.00	478.58	504.50	615.05	575.93
061_00_2018_002_36.02	Thames (Sandford to Mapledurham) 2018	471382	174400	218.78	282.79	377.25	0.00	474.16	499.61	608.33	569.90
061_00_2018_002_36.02	Thames (Sandford to Mapledurham) 2018	471287	174474	218.79	282.17	376.75	0.00	474.55	501.04	609.06	571.28
061_00_2018_002_36.03	Thames (Sandford to Mapledurham) 2018	471206	174519	218.79	283.66	382.28	0.00	484.80	512.15	624.31	585.50

Note:

Due to changes in guidance on the allowances for climate change, the 20% increase in river flows should no longer to be used for development design purposes. The data included in this Product can be used for interpolation of levels as part of an intermediate level assessment.

For further advice on the new allowances please visit
<https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances>



Modelled floodplain flood levels

THM118462

The modelled flood levels for the closest most appropriate model grid cells for your site are provided below:

2D grid cell reference	Model	Easting	Northing	flood levels (mAOD)								
				20% AEP	5% AEP	1% AEP	1% AEP (+20% increase in flows)	1% AEP (+25% increase in flows)	1% AEP (+35% increase in flows)	1% AEP (+70% increase in flows)	0.5% AEP	0.1% AEP
Floodplain 1	Thames (Sandford to Mapledurham) 2018	471,231	174,043	No data	No data	No data	No data	38.29	38.35	38.55	38.17	38.49
Floodplain 2	Thames (Sandford to Mapledurham) 2018	471,307	174,126	No data	No data	No data	No data	38.28	38.34	38.53	38.16	38.47
Floodplain 3	Thames (Sandford to Mapledurham) 2018	471,143	174,105	No data	No data	No data	No data	38.29	38.36	38.56	38.17	38.50

This flood model has represented the floodplain as a grid.
The flood water levels have been calculated for each grid cell.

Note:

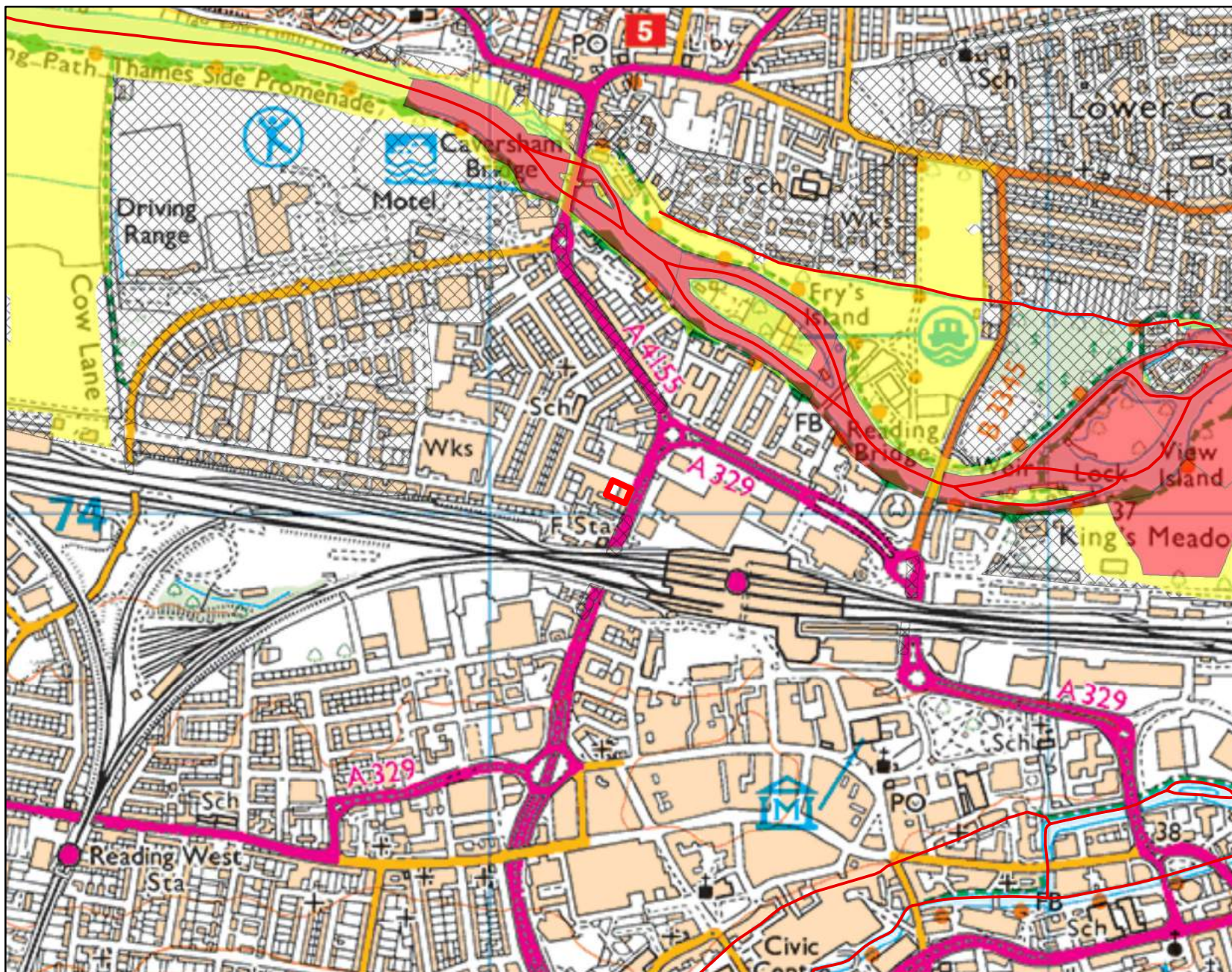
Due to changes in guidance on the allowances for climate change, the 20% increase in river flows should no longer to be used for development design purposes. The data included in this Product can be used for interpolation of levels as part of an intermediate level assessment.

For further advice on the new allowances please visit

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

Historic Flood Map centred on RG1 8JA

Created on 28/03/19 REF:THM118462



Kilometres

0 0.25 0.5

Legend

— Main River

year

1947

1974

1977

2000

2002

2007

Flooding from rivers or sea without defences (Flood Zone 3) shows the area that could be affected by flooding:

- from the sea with a 1 in 200 or greater chance of happening each year
- or from a river with a 1 in 100 or greater chance of happening each year.

The Extent of an extreme flood (Flood Zone 2) shows the extent of an extreme flood from rivers or the sea with up to a 1 in 1000 chance of occurring each year.

Historic flood data

THM118462

Our records show that the area of your site has been affected by flooding. Information on the floods that have affected your site is provided in the table below:

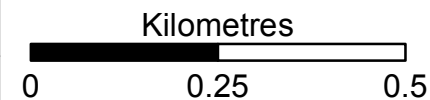
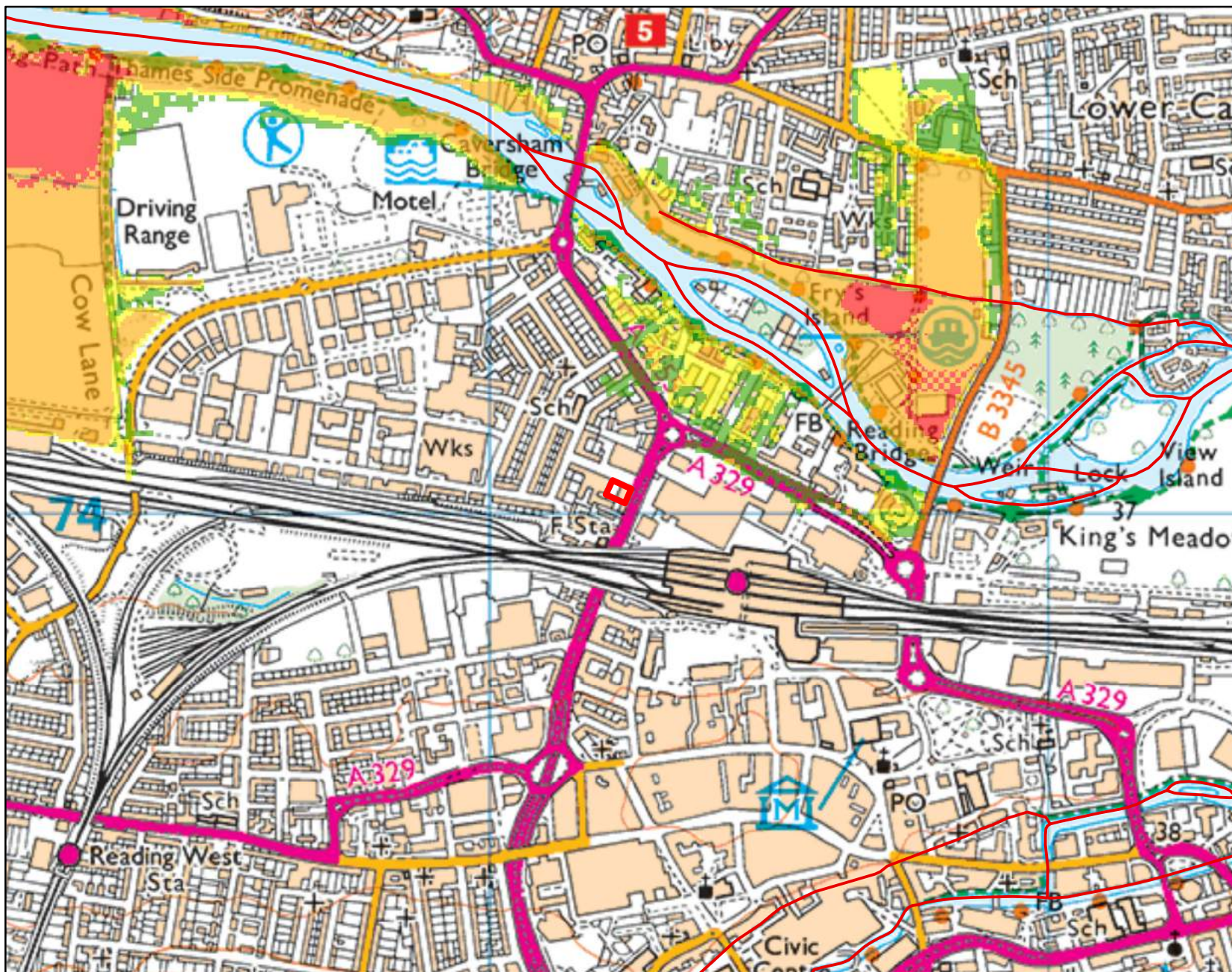
[illegible]

Please note the Environment Agency maps flooding to land not individual properties. Floodplain extents are an indication of the geographical extent of a historic flood. They do not provide information regarding levels of individual properties, nor do they imply that a property has flooded internally.

Start and End Dates shown above may represent a wider range where the exact dates are not available.

Hazard Map centred on RG1 8JA

Created on 28/03/19 REF:THM118462



Legend

- Main River
- Low hazard
- Hazard to some
- Hazard for most
- Hazard to all

Hazard Mapping

Hazard Mapping methodology:

To calculate flood hazard with the debris factor we have used the supplementary note to Flood Risk to People Methodology (see below).

The following calculation is used:

$$HR = d \times (v+0.5) + DF$$

Where HR = flood hazard rating

d = depth of flooding (m)

v = velocity of floodwaters (m/sec)

DF = debris factor calculated (0, 0.5, 1 depending on probability that debris will lead to a hazard)

The resultant hazard rating is then classified according to:

Flood Hazard	Colour	Hazard to People Classification
Less than 0.75	Green	Very low hazard - Caution
0.75 to 1.25	Yellow	Danger for some - includes children, the elderly and the infirm
1.25 to 2.0	Orange	Danger for most - includes the general public
More than 2.0	Red	Danger for all - includes the emergency services

REF: HR Wallingford and Environment Agency (May 2008) Supplementary note of flood hazard ratings and thresholds for development planning and control purpose – Clarification of the Table 113.1 of FD2320/TR2 and Figure 3.2 of FD2321/TR1

Appendix B

Thames Water Capacity Check Response

Rachel Shepherd

From: Naomi Ward
Sent: 14 August 2019 13:06
To: Rachel Shepherd
Subject: FW: Pre-development Enquiry: 71 – 73 Caversham Road, Reading, RG1 8JA

Hi Rachel.

Please see response below.

Naomi

Naomi Ward

Environmental Consultant
RPS | Consulting UK & Ireland
T +44 161 786 8550
E naomi.ward@rpsgroup.com

From: Andrew John <Andrew.John@thameswater.co.uk>
Sent: 14 August 2019 12:47
To: Naomi Ward <Naomi.Ward@rpsgroup.com>
Subject: RE: Pre-development Enquiry: 71 – 73 Caversham Road, Reading, RG1 8JA

CAUTION: This email originated from outside of RPS.

Hi Naomi,

If your proposal is to provide a restriction to surface water flows to a max 2l/s were before no restriction existed. This could be classed as betterment. Your design will still have to follow the surface water drainage heirachy and if connection to a surface water sewer is the only alternative provide attenuation within your site for exceedance flows.

Kind Regards

Andy

From: Naomi Ward [<mailto:Naomi.Ward@rpsgroup.com>]
Sent: 14 August 2019 12:32
To: Andrew John
Subject: RE: Pre-development Enquiry: 71 – 73 Caversham Road, Reading, RG1 8JA

Hi Andrew,

We don't have a site drainage survey but it is inferred that surface water runoff currently passes to the surface water sewer at present. The current discharge rate has not yet been estimated, but will be significantly more than 2 l/s.

In our report we will follow the drainage hierarchy, where feasible, as per national guidance.

As Thames Water's standard condition is that surface water discharge should be limited to 5 litres per hectare, can I confirm that proposed reduction to 2 l/s would be acceptable?

Kind Regards

Naomi Ward

From: Andrew John <Andrew.John@thameswater.co.uk>
Sent: 13 August 2019 12:15
To: Naomi Ward <Naomi.Ward@rpsgroup.com>
Subject: RE: Pre-development Enquiry: 71 – 73 Caversham Road, Reading, RG1 8JA

CAUTION: This email originated from outside of RPS.

Hi Naomi,

Thanks for your email. Before connection of the surface water to a sewer can be approved, the drainage hierarchy set out below should be followed. Thames Waters standard condition is that surface water discharge should be limited to 5 litres per hectare.

Could you confirm the existing site discharges into Thames Waters sewers, If so to which one Foul or Surface and the current discharge rate?

Kind Regards

Andrew John

Developer Services | Sewer Adoptions Team

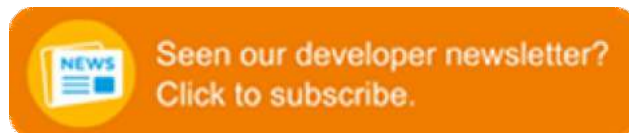
Office: 0203 5779018

Andrew.John@thameswater.co.uk

Get advice on making your sewer connection correctly at connectright.org.uk

Clearwater Court, Vastern Road, Reading, RG1 8DB

Find us online at developers.thameswater.co.uk



From: Naomi Ward [<mailto:Naomi.Ward@rpsgroup.com>]
Sent: 13 August 2019 10:52
To: Andrew John
Subject: FW: Pre-development Enquiry: 71 – 73 Caversham Road, Reading, RG1 8JA

Hi Andrew,

Many thanks for your response.

I realised looking at my original application to you that I did not state the rate at which we are hoping to discharge at.

We are proposing to discharge surface water at a rate of 2 l/s. Would this be acceptable for Thames Water?

Kind Regards

Naomi Ward

Environmental Consultant
RPS | Consulting UK & Ireland
T +44 161 786 8550
E naomi.ward@rpsgroup.com

From: DEVELOPER.SERVICES@THAMESWATER.CO.U <DEVELOPER.SERVICES@THAMESWATER.CO.UK>

Sent: 13 August 2019 09:51

To: Naomi Ward <Naomi.Ward@rpsgroup.com>

Cc: Daniel Percival <daniel.percival@rpsgroup.com>

Subject: RE: Pre-development Enquiry: 71 – 73 Caversham Road, Reading, RG1 8JA

CAUTION: This email originated from outside of RPS.

Dear Naomi,

Thank you for your pre-planning application. Thames Waters Asset planners have looked at your submission and confirmed that capacity currently exists for the foul water flows from this development. For the discharge of surface water flows, the following hierarchy must be followed;-

1. use of soakaways
2. discharge to water courses
3. connection to surface water sewer

The attached formal response provides more information.

If you would like to discuss this application please give me a call.

Kind Regards

Andrew John

Developer Services | Sewer Adoptions Team

Office: 0203 5779018

Andrew.John@thameswater.co.uk

Get advice on making your sewer connection correctly at connectright.org.uk

Clearwater Court, Vastern Road, Reading, RG1 8DB

Find us online at developers.thameswater.co.uk

From: Naomi Ward <Naomi.Ward@rpsgroup.com>

To: DEVELOPER.SERVICES@THAMESWATER.CO.U <DEVELOPER.SERVICES@THAMESWATER.CO.UK>

CC: Daniel Percival <daniel.percival@rpsgroup.com>

Sent: 01.08.19 16:49:44

Subject: Pre-development Enquiry: 71 – 73 Caversham Road, Reading, RG1 8JA

Dear Sir/Madam,

Please find attached details of a site located at **71 – 73 Caversham Road, Reading, RG1 8JA**

NGR: SU 71240 74049 X (E) 471240, Y (N) 174049.

The proposal is for the demolition of the existing corner building fronting Caversham Road/Northfield Road and the erection of a new residential building with commercial at ground floor and 44 flats spread over 7 storeys. Development plans are attached for reference.

Could Thames Water please confirm its capacity to supply clean water and accommodate the discharge of wastewater and provide appropriate rates for the proposed 44 flats and commercial space on the ground floor?

In the event that your system does not hold sufficient capacity for our proposed development, we are anticipating that you will be able to provide us with a budget estimate for any upgrade works that will be required to accommodate our proposal.

Do let me know if there is anything further I can supply to assist with my enquiry.

Kind Regards

Naomi Ward

Environmental Consultant
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8 Exchange Quay
Salford, Greater Manchester M5 3EJ, United Kingdom
T +44 161 786 8550
D 01617868550 **M** 07514951026
E naomi.ward@rpsgroup.com
rpsgroup.com



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RPS Group Plc web link: <http://www.rpsgroup.com>

Visit us online www.thameswater.co.uk , follow us on twitter www.twitter.com/thameswater or find us on www.facebook.com/thameswater. We're happy to help you 24/7.

Appendix C

Topographic Survey

Shurgard Self-Storage



Warning:
For safety reasons all underground drainage details are by visual inspection only.

Drainage must be verified on site before the commencement of any works.

All tree information is indicative and if required should be verified by a specialist .

Abbreviations:

BE	Bare Earth	OBF	Open Board Fence
Bo	Bollard	O/H	Overhead
BP	Brick Paving	OHC	Overhead Cable
BRW	Brick Retaining Wall	P	Post
BS	Bus Stop	PCF	Post & Chain Fence
BW	Brick Wall	PWL	Parapet Wall Level
CIC	Cable TV	PRF	Post & Rail Fence
CBF	Close Board Fence	PWF	Post & Wire Fence
ICL	Cover Level	RE	Rodding Eye
CLF	Chain Link Fence	RG	Road Gully
Conc	Concrete	RL	Ridge Level
CPS	Concrete Paving Slabs	RNP	Road Name Plate
DC	Drainage Channel	RS	Road Sign
Dk	Drop Kerb	RW	Retaining Wall
DT	Door Threshold	RWP	Rain Water Pipe
E	Electricity	SB	Silver Birch
EL	Eaves Level	SC	Sign Post
EP	Electricity Pole	Stop	Stop Cock
ER	Earthing Rod	SPF	Stock Proof Fence
FH	Fire Hydrant	SRW	Stone Retaining Wall
FRL	Flat Roof Level	St	Stump
GV	Gas	SV	Stop Valve
GP	Gate Post	SW	Stone Wall
Gu	Gully	Syc	Sycamore
h	Height (metres)	T	Telephone
IL	Invert Level	TFL	Top of Fence Level
IR	Iron Railing	TPav	Tactile Paving
IRF	Iron Railing Fence	U	Unidentified
JB	Junction Box	UTL	Unable to Lift
LB	Letter Box	V	Vent
LP	Lamp Post	VP	Vent Pipe
Mkr	Marker	WSV	Water
IC	Inspection Cover		
MPF	Metal Palisade Fence		

Benchmark Details:

Survey Grid set to Ordnance Survey Grid via RTK network.

All Levels related to Ordnance Survey Datum via RTK network.

Drawing Title:

Topographical Survey

Job Title:

71-73
Caversham Road
Reading
RG1 8AH

Scale: 1/200

Size: A2

Date: Feb 2019



Northfield Road

Caversham Road

Drews

PureGym

The Brewery & The Malthouse

Monmouth Court

Appendix D

Development Plans

Notes

Do not scale from this drawing.
All contractors must visit the site and be responsible for taking and checking dimensions.
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Rev	Date	Description	Drawn	Chkd
-----	------	-------------	-------	------

Drawing Status
7 Storey Option - FOR INFORMATION

Client
S2 Estates



JTP Studios, Unit 5
The Rum Warehouse
Pennington Street
London, E1W 2AP
+44 (0) 20 7017 1780
www.jtp.co.uk

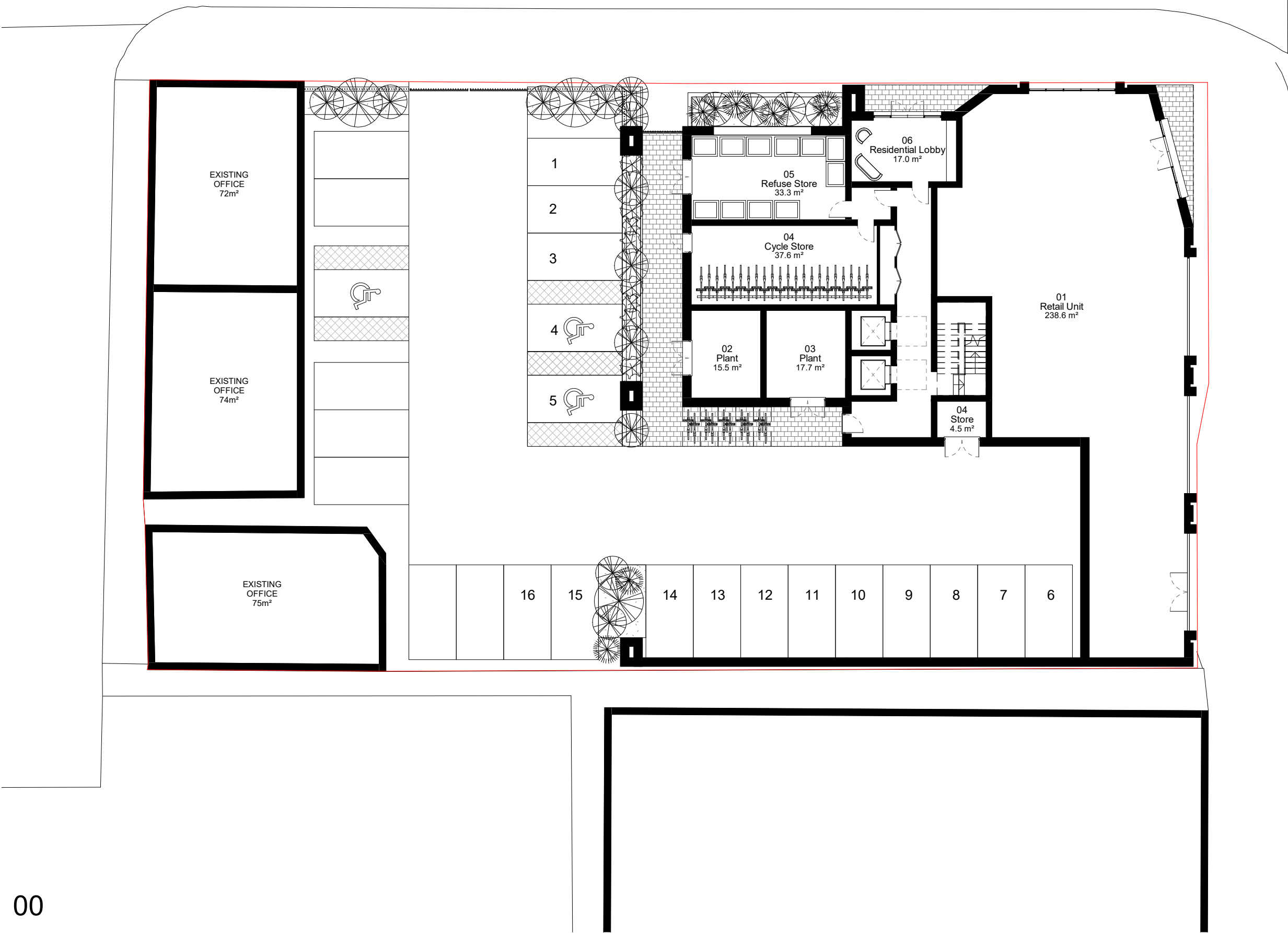
Project
Caversham Road, Reading

Drawing Title
Proposed Ground Floor Plan

Scale @A31 : 200Job Ref. 01662

Drawing No. P01Revision.

Scale Bar0246 m



RTHFIELD ROAD

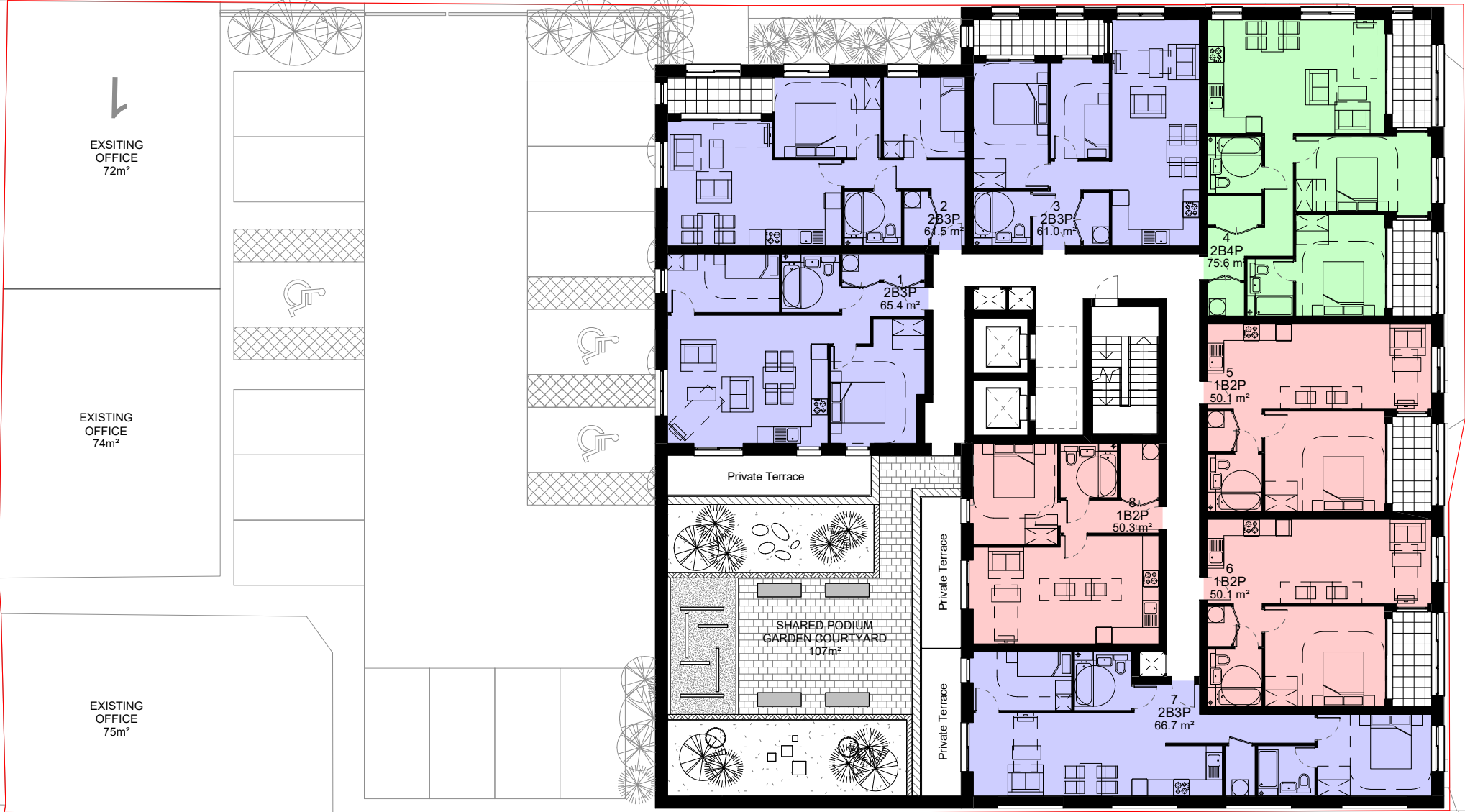
Apartment Type

- 1B2P
- 2B3P
- 2B4P

Notes

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jtp

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+44 (0) 20 7017 1780
www.jtp.co.uk

Project
Caversham Road, Reading

Drawing Title
Proposed First Floor Plan

Scale @A3 1 : 200

Job Ref. 01662

Drawing No. P02

Revision.

Scale Bar

0 2 4 6 m

RTHFIELD ROAD

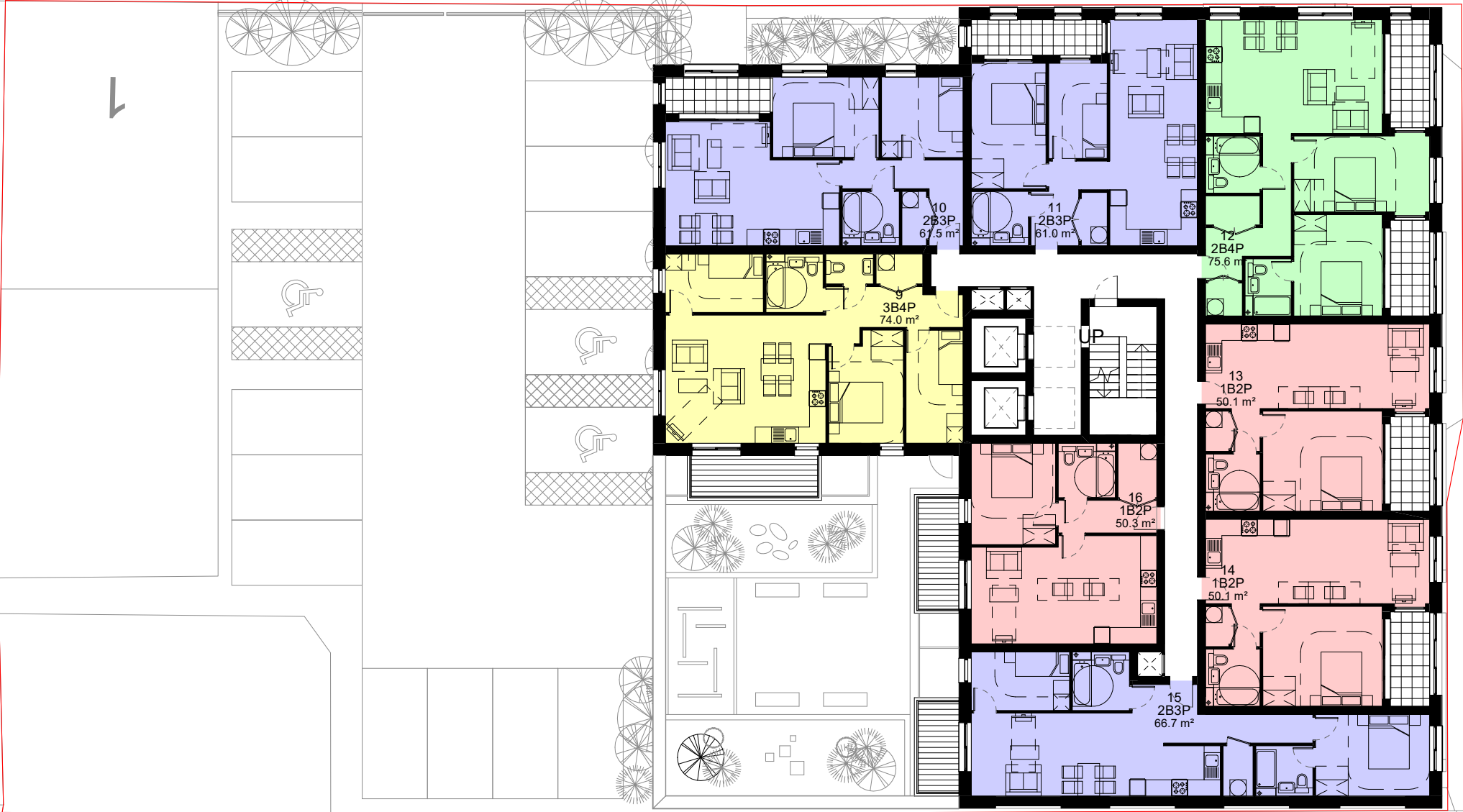
Apartment Type

- 1B2P
- 2B3P
- 2B4P
- 3B4P

Notes

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www.jtp.co.uk

Project
Caversham Road, Reading

Drawing Title
Proposed Second Floor Plan

Scale @A3 1 : 200 Job Ref. 01662

Drawing No. P03 Revision.

Scale Bar 0 2 4 6 m

RTHFIELD ROAD

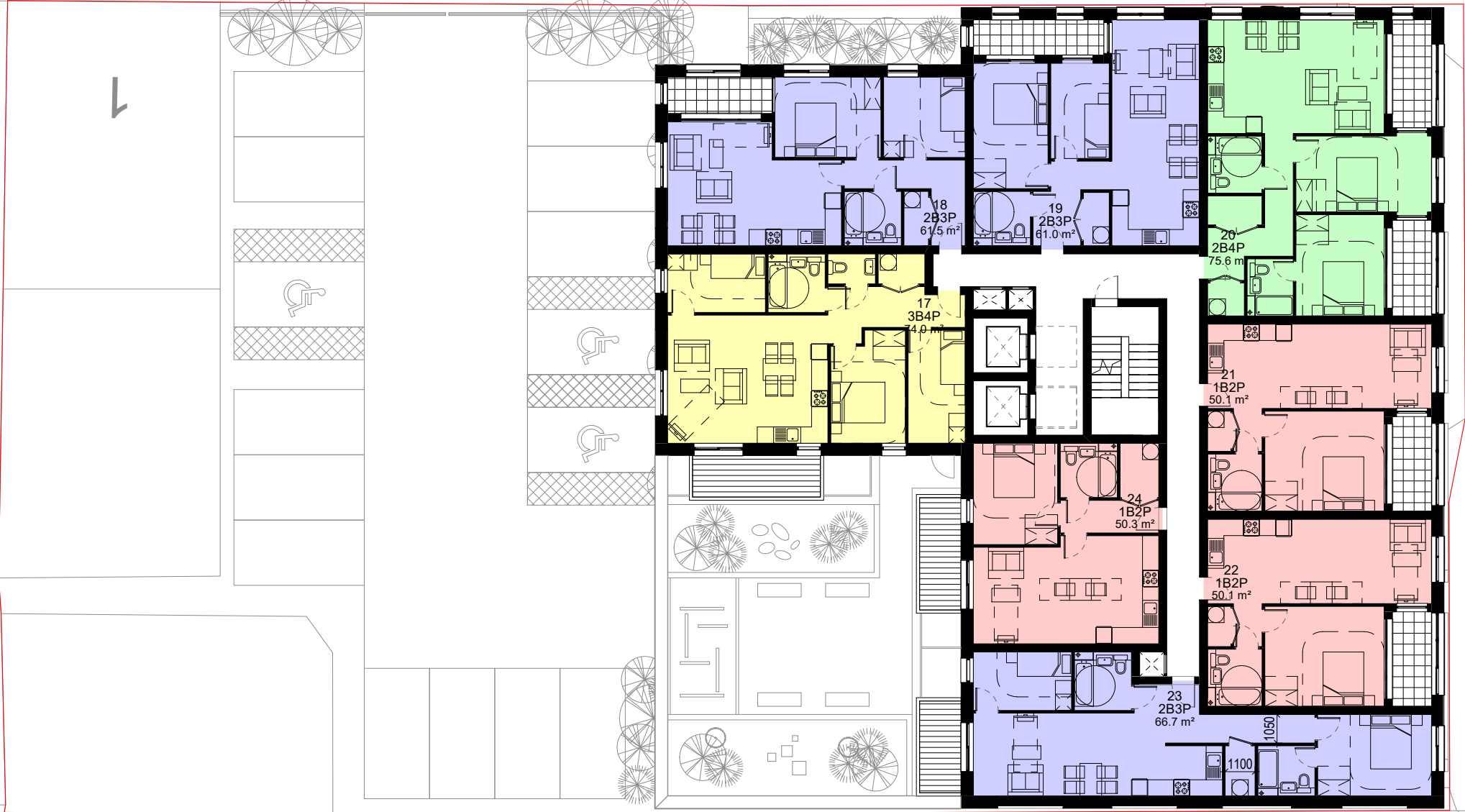
Apartment Type

- 1B2P
- 2B3P
- 2B4P
- 3B4P

Notes

Do not scale from this drawing.
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Rev	Date	Description	Drawn	Chkd
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S2 Estates

jtp
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London, E1W 2AP
+44 (0) 20 7017 1780
www.jtp.co.uk

Project
Caversham Road, Reading

Drawing Title
Proposed Third Floor Plan

Scale @A3 1 : 200 Job Ref. 01662

Drawing No. P04 Revision.

Scale Bar
0 2 4 6 m



RTHFIELD ROAD

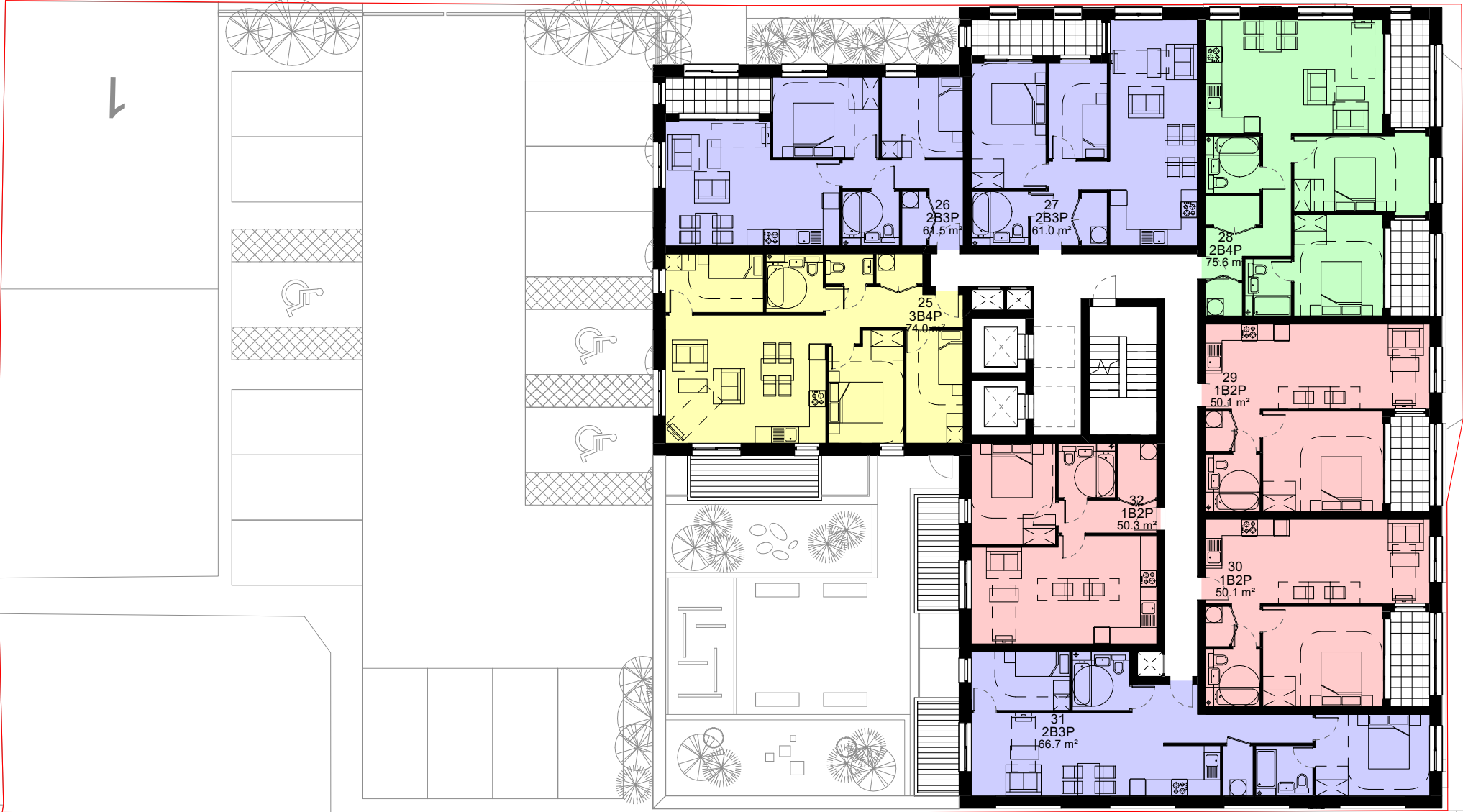
Apartment Type

- 1B2P
- 2B3P
- 2B4P
- 3B4P

Notes

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Rev	Date	Description	Drawn	Chkd
-----	------	-------------	-------	------

Drawing Status
7 Storey Option - FOR INFORMATION

Client
S2 Estates



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Pennington Street
London, E1W 2AP
+44 (0) 20 7017 1780
www.jtp.co.uk

Project
Caversham Road, Reading

Drawing Title
Proposed Fourth Floor Plan

Scale @A3 1 : 200 Job Ref. 01662

Drawing No. P05 Revision.

Scale Bar 0 2 4 6 m



RTHFIELD ROAD

Apartment Type

- 1B2P
- 2B3P
- 2B4P

Notes

Do not scale from this drawing.
All contractors must visit the site and be responsible for taking and checking dimensions.
All construction information should be taken from figured dimensions only.
Any discrepancies between drawings, specifications and site conditions must be brought to the attention of the supervising officer.
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Rev	Date	Description	Drawn	Chkd
-----	------	-------------	-------	------

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7 Storey Option - FOR INFORMATION

Client
S2 Estates

jtp
JTP Studios, Unit 5
The Rum Warehouse
Pennington Street
London, E1W 2AP
+44 (0) 20 7017 1780
www.jtp.co.uk

Project
Caversham Road, Reading

Drawing Title
Proposed Fifth Floor Plan

Scale @A3	1 : 200	Job Ref.	01662
Drawing No.	P06	Revision.	
Scale Bar	0 2 4 6 m		



RTHFIELD ROAD

Apartment Type

- 1B2P
- 2B3P

Notes

Do not scale from this drawing.
All contractors must visit the site and be responsible for taking and checking dimensions.
All construction information should be taken from figured dimensions only.
Any discrepancies between drawings, specifications and site conditions must be brought to the attention of the supervising officer.
This drawing & the works depicted are the copyright of JTP.

This drawing is prepared for the specific project stage in the Drawing Status section below and it is not intended to be used for any other purpose. Whilst all reasonable efforts are used to ensure drawings are accurate, JTP accept no liability for any reliance placed on, or use made of, this plan by anyone for purposes other than those stated in the Drawing Status below.



Rev	Date	Description	Drawn	Chkd
-----	------	-------------	-------	------

Drawing Status
7 Storey Option - FOR INFORMATION

Client
S2 Estates



JTP Studios, Unit 5
The Rum Warehouse
Pennington Street
London, E1W 2AP
+44 (0) 20 7017 1780
www.jtp.co.uk

Project
Caversham Road, Reading

Drawing Title
Proposed Sixth Floor Plan

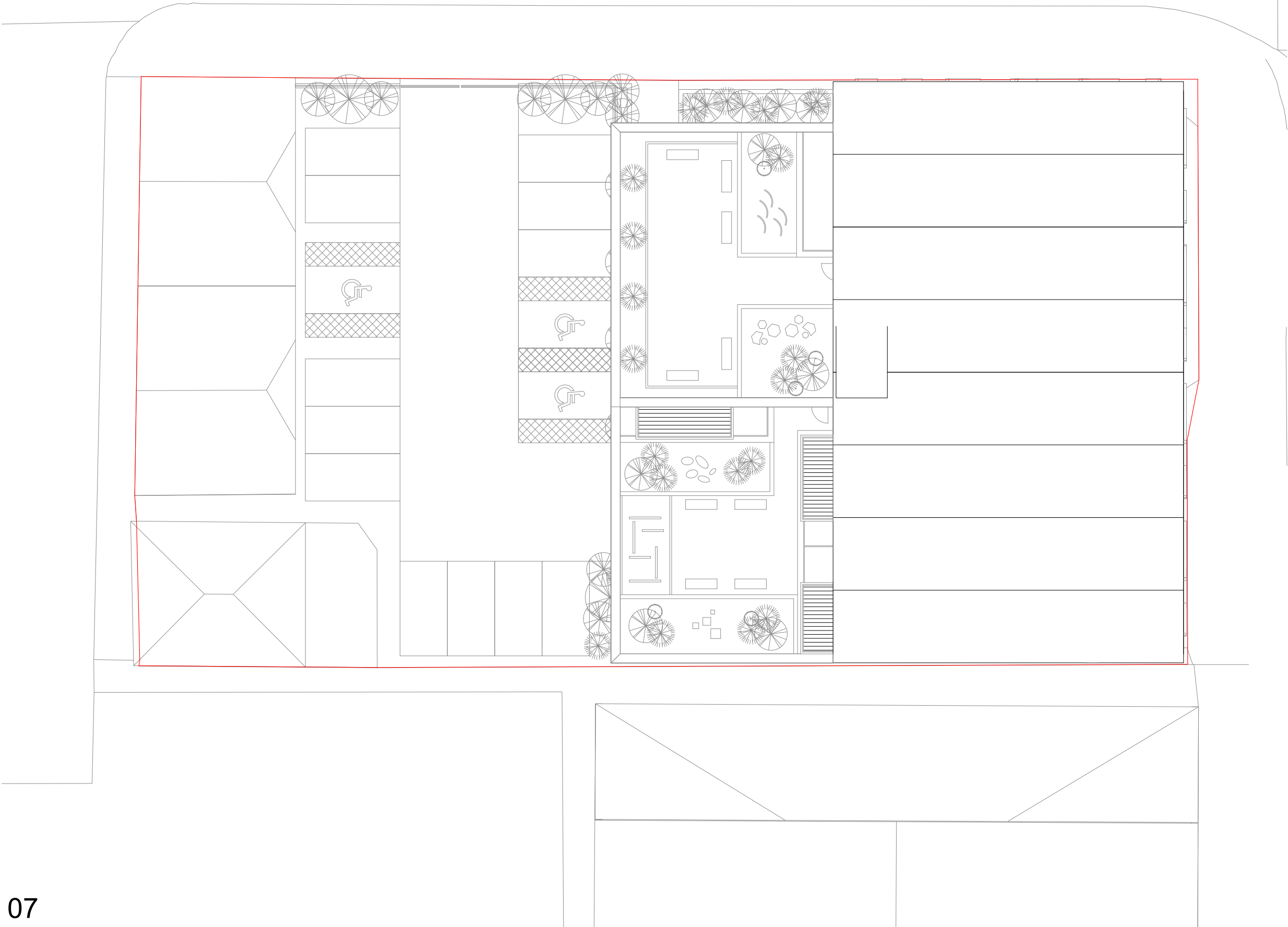
Scale @A3 1 : 200 Job Ref. 01662

Drawing No. P07 Revision.

Scale Bar
0 2 4 6 m



RTHFIELD ROAD



Notes

Do not scale from this drawing.
All contractors must visit the site and be responsible for taking and checking dimensions.
All construction information should be taken from figured dimensions only.
Any discrepancies between drawings, specifications and site conditions must be brought to the attention of the supervising officer.
This drawing & the works depicted are the copyright of JTP.

This drawing is prepared for the specific project stage in the Drawing Status section below and it is not intended to be used for any other purpose. Whilst all reasonable efforts are used to ensure drawings are accurate, JTP accept no liability for any reliance placed on, or use made of, this plan by anyone for purposes other than those stated in the Drawing Status below.

Rev	Date	Description	Drawn	Chkd
-----	------	-------------	-------	------

Drawing Status
7 Storey Option - FOR INFORMATION

Client
S2 Estates



JTP Studios, Unit 5
The Rum Warehouse
Pennington Street
London, E1W 2AP
+44 (0) 20 7017 1780
www.jtp.co.uk

Project
Caversham Road, Reading

Drawing Title
Proposed Roof Plan

Scale @A3 1 : 200

Drawing No. P08

Scale Bar

Job Ref. 01662

Revision.





Appendix E

Flood Hazard Mapping



Site

Modelled maximum Hazard

- 'Hazard to all'
- 'Hazard to most'
- 'Hazard to some'
- 'Very low Hazard'

Based on Hazard classification FD2320/TR2



8 Exchange Quay,
Manchester, M5 3EJ.
T: +44 (0)161 786 8550
W: rpsgroup.com

Client: S2 Caversham Limited

Title: Maximum modelled Hazard Rating:
100 year +25% CC event

Site: Caversham Road, Reading

Date: 03.05.2019

Scale: NTS	Figure: A	Size: A3
------------	-----------	----------

Job ref: HLEF71415	Rev: 00
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Site

Modelled maximum Hazard



'Hazard to all'



'Hazard to most'



'Hazard to some'



'Very low Hazard'

Based on Hazard classification FD2320/
TR2



8 Exchange Quay,
Manchester, M5 3EJ.
T: +44 (0)161 786 8550
W: rpsgroup.com

Client: S2 Caversham Limited

Title: Maximum modelled Hazard Rating:
100 year +35% CC event

Site: Caversham Road, Reading

Date: 03.05.2019

Scale: NTS

Figure: B

Size: A3

Job ref: HLEF71415

Rev: 00

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Appendix F

Thames Water Sewer Plans

Asset location search



Property Searches

RPS Health, Safety and Environment
35 New Bridge Street
LONDON
EC4V 6BW

Search address supplied 71-75
Caversham Road
Reading
RG1 8JA

Your reference HLEF71415

Our reference ALS/ALS Standard/2019_3984534

Search date 11 April 2019

Keeping you up-to-date

Notification of Price Changes

From 1 September 2018 Thames Water Property Searches will be increasing the price of its Asset Location Search in line with RPI at 3.23%.

For further details on the price increase please visit our website: www.thameswater-propertysearches.co.uk
Please note that any orders received with a higher payment prior to the 1 September 2018 will be non-refundable.



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



Search address supplied: 71-75, Caversham Road, Reading, RG1 8JA

Dear Sir / Madam

An Asset Location Search is recommended when undertaking a site development. It is essential to obtain information on the size and location of clean water and sewerage assets to safeguard against expensive damage and allow cost-effective service design.

The following records were searched in compiling this report: - the map of public sewers & the map of waterworks. Thames Water Utilities Ltd (TWUL) holds all of these.

This search provides maps showing the position, size of Thames Water assets close to the proposed development and also manhole cover and invert levels, where available.

Please note that none of the charges made for this report relate to the provision of Ordnance Survey mapping information. The replies contained in this letter are given following inspection of the public service records available to this company. No responsibility can be accepted for any error or omission in the replies.

You should be aware that the information contained on these plans is current only on the day that the plans are issued. The plans should only be used for the duration of the work that is being carried out at the present time. Under no circumstances should this data be copied or transmitted to parties other than those for whom the current work is being carried out.

Thames Water do update these service plans on a regular basis and failure to observe the above conditions could lead to damage arising to new or diverted services at a later date.

Contact Us

If you have any further queries regarding this enquiry please feel free to contact a member of the team on 0845 070 9148, or use the address below:

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

Email: searches@thameswater.co.uk

Web: www.thameswater-propertysearches.co.uk

Waste Water Services

Please provide a copy extract from the public sewer map.

Enclosed is a map showing the approximate lines of our sewers. Our plans do not show sewer connections from individual properties or any sewers not owned by Thames Water unless specifically annotated otherwise. Records such as "private" pipework are in some cases available from the Building Control Department of the relevant Local Authority.

Where the Local Authority does not hold such plans it might be advisable to consult the property deeds for the site or contact neighbouring landowners.

This report relates only to sewerage apparatus of Thames Water Utilities Ltd, it does not disclose details of cables and or communications equipment that may be running through or around such apparatus.

The sewer level information contained in this response represents all of the level data available in our existing records. Should you require any further Information, please refer to the relevant section within the 'Further Contacts' page found later in this document.

For your guidance:

- The Company is not generally responsible for rivers, watercourses, ponds, culverts or highway drains. If any of these are shown on the copy extract they are shown for information only.
- Any private sewers or lateral drains which are indicated on the extract of the public sewer map as being subject to an agreement under Section 104 of the Water Industry Act 1991 are not an 'as constructed' record. It is recommended these details be checked with the developer.

Clean Water Services

Please provide a copy extract from the public water main map.

Enclosed is a map showing the approximate positions of our water mains and associated apparatus. Please note that records are not kept of the positions of individual domestic supplies.

For your information, there will be a pressure of at least 10m head at the outside stop valve. If you would like to know the static pressure, please contact our Customer Centre on 0800 316 9800. The Customer Centre can also arrange for a full flow and pressure test to be carried out for a fee.



For your guidance:

- Assets other than vested water mains may be shown on the plan, for information only.
- If an extract of the public water main record is enclosed, this will show known public water mains in the vicinity of the property. It should be possible to estimate the likely length and route of any private water supply pipe connecting the property to the public water network.

Payment for this Search

A charge will be added to your suppliers account.

Further contacts:

Waste Water queries

Should you require verification of the invert levels of public sewers, by site measurement, you will need to approach the relevant Thames Water Area Network Office for permission to lift the appropriate covers. This permission will usually involve you completing a TWOSA form. For further information please contact our Customer Centre on Tel: 0845 920 0800. Alternatively, a survey can be arranged, for a fee, through our Customer Centre on the above number.

If you have any questions regarding sewer connections, budget estimates, diversions, building over issues or any other questions regarding operational issues please direct them to our service desk. Which can be contacted by writing to:

Developer Services (Waste Water)
Thames Water
Clearwater Court
Vastern Road
Reading
RG1 8DB

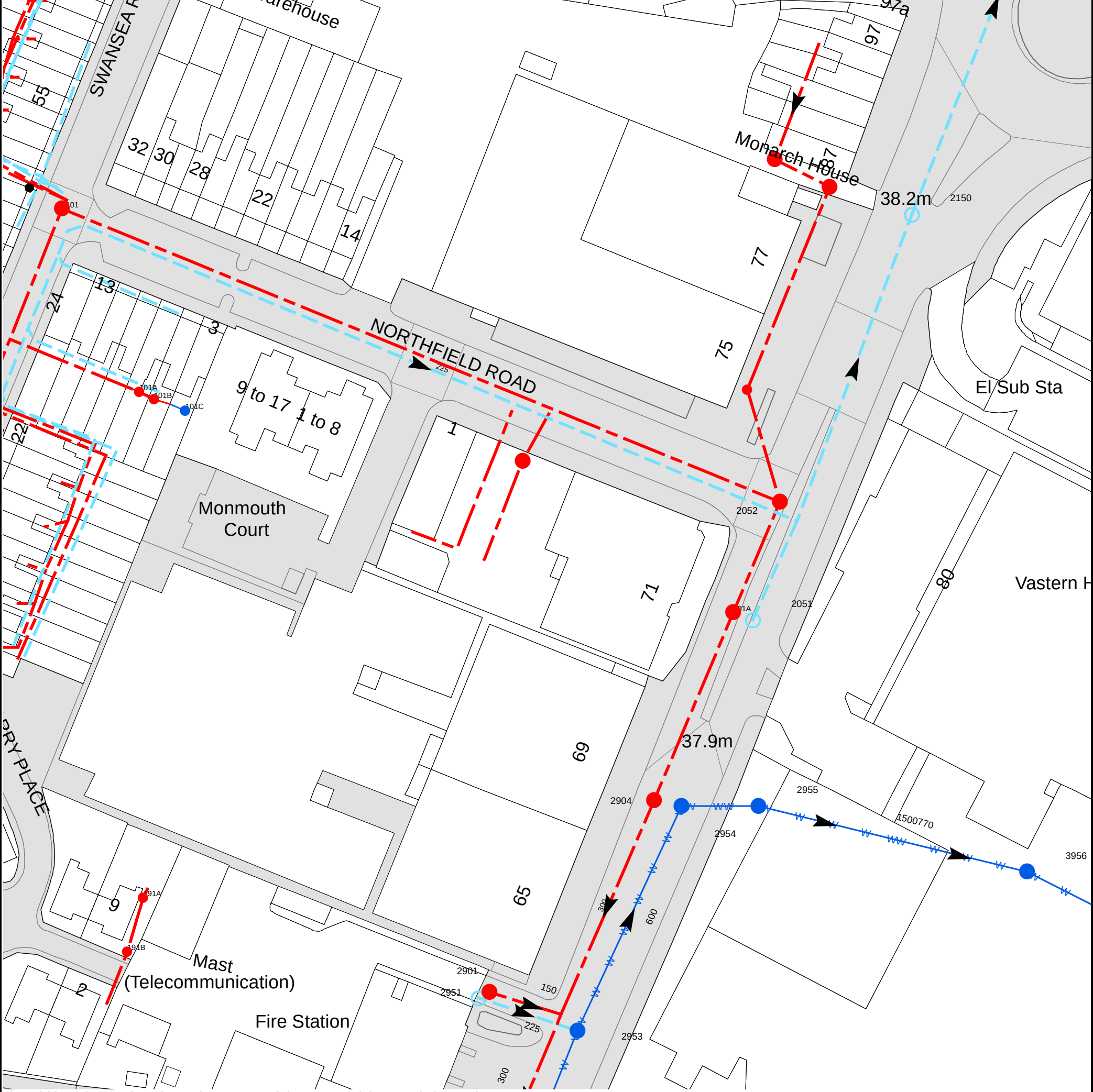
Tel: 0800 009 3921
Email: developer.services@thameswater.co.uk

Clean Water queries

Should you require any advice concerning clean water operational issues or clean water connections, please contact:

Developer Services (Clean Water)
Thames Water
Clearwater Court
Vastern Road
Reading
RG1 8DB

Tel: 0800 009 3921
Email: developer.services@thameswater.co.uk



The width of the displayed area is 200 m and the centre of the map is located at OS coordinates 471230,174045
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.

Based on the Ordnance Survey Map with the Sanction of the controller of H.M. Stationery Office, License no. 100019345 Crown Copyright Reserved.

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
1101	38.24	36.59
21NH	n/a	n/a
21NF	n/a	n/a
2150	n/a	n/a
2953	37.83	n/a
2951	38.06	36.67
2901	38.05	36.26
191B	n/a	n/a
191A	n/a	n/a
3956	37.94	35.91
2955	38.25	36.07
2954	37.91	n/a
2904	37.97	n/a
2051	n/a	n/a
201A	n/a	n/a
2052	n/a	n/a
20ZX	n/a	n/a
101C	n/a	n/a
101B	n/a	n/a
101A	n/a	n/a
20NJ	n/a	n/a
The position of the apparatus shown on this plan is given without obligation and warranty, and the accuracy cannot be guaranteed. Service pipes are not shown but their presence should be anticipated. No liability of any kind whatsoever is accepted by Thames Water for any error or omission. The actual position of mains and services must be verified and established on site before any works are undertaken.		



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

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.

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		Gully
	Culverted Watercourse		Proposed
			Abandoned Sewer



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.

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

Valves

	General Purpose Valve
	Air Valve
	Pressure Control Valve
	Customer Valve

Hydrants

	Single Hydrant
--	----------------

Meters

	Meter
--	-------

End Items

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

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

Operational Sites

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

Other Symbols

	Data Logger
--	-------------

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: Indicates 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.
6. Penalty interest may be invoked by TWUL in the event of unjustifiable payment delay. Interest charges will be in line with UK Statute Law 'The Late Payment of Commercial Debts (Interest) Act 1998'.
7. Interest will be charged in line with current Court Interest Charges, if legal action is taken.
8. A charge may be made at the discretion of the company for increased administration costs.

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

We publish several Codes of Practice including a guaranteed standards scheme. You can obtain copies of these leaflets by calling us on 0800 316 9800

If you are unhappy with our service you can speak to your original goods or customer service provider. If you are not satisfied with the response, your complaint will be reviewed by the Customer Services Director. You can write to her at: Thames Water Utilities Ltd. PO Box 492, Swindon, SN38 8TU.

If the Goods or Services covered by this invoice falls under the regulation of the 1991 Water Industry Act, and you remain dissatisfied you can refer your complaint to Consumer Council for Water on 0121 345 1000 or write to them at Consumer Council for Water, 1st Floor, Victoria Square House, Victoria Square, Birmingham, B2 4AJ.

Ways to pay your bill

Credit Card	BACS Payment	Telephone Banking	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

Thames Water Utilities Ltd Registered in England & Wales No. 2366661 Registered Office Clearwater Court, Vastern Rd, Reading, Berks, RG1 8DB.



Search Code

IMPORTANT CONSUMER PROTECTION INFORMATION

This search has been produced by Thames Water Property Searches, Clearwater Court, Vastern Road, Reading RG1 8DB, which is registered with the Property Codes Compliance Board (PCCB) as a subscriber to the Search Code. The PCCB independently monitors how registered search firms maintain compliance with the Code.

The Search Code:

- provides protection for homebuyers, sellers, estate agents, conveyancers and mortgage lenders who rely on the information included in property search reports undertaken by subscribers on residential and commercial property within the United Kingdom
- sets out minimum standards which firms compiling and selling search reports have to meet
- promotes the best practise and quality standards within the industry for the benefit of consumers and property professionals
- enables consumers and property professionals to have confidence in firms which subscribe to the code, their products and services.

By giving you this information, the search firm is confirming that they keep to the principles of the Code. This provides important protection for you.

The Code's core principles

Firms which subscribe to the Search Code will:

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

Complaints

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

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

TPOs Contact Details

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

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

PLEASE ASK YOUR SEARCH PROVIDER IF YOU WOULD LIKE A COPY OF THE SEARCH CODE

Appendix G

Pre / Post Development Runoff Rates and Volumes

PRE/POST DEVELOPMENT RUNOFF RATES

Introduction

- 1.1 The rainfall used to derive the surface water runoff rates and volumes was obtained from the Flood Estimation Handbook (FEH) Web Service, depth-duration-frequency model. This provides design rainfall intensities for a range of return periods and storm durations.
- 1.2 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 and 0.3 was applied for the impermeable and the permeable areas in line with best practise for surface water runoff estimation.

Existing Surface Water Runoff Rates

- 1.3 The site currently consists entirely of impermeable area totalling 1590 m². Existing surface water runoff rates and volumes for a range of return periods, including climate change, are presented in Tables 1 and 2 below.

Table 1 – Existing Surface Water Runoff Rates (l/s)

	Storm Durations (hr)								
	0.25	0.5	1	2	3	5	12	24	48
1	10.6	6.8	4.2	3.0	2.4	1.8	1.0	0.6	0.3
2	15.3	9.7	6.0	4.1	3.2	2.2	1.2	0.7	0.4
5	21.6	13.9	8.6	5.5	4.2	2.9	1.5	0.8	0.5
10	26.7	17.2	10.6	6.6	5.0	3.4	1.7	1.0	0.6
30	34.8	22.6	14.1	8.4	6.3	4.2	2.1	1.2	0.7
50	38.8	25.4	15.8	9.3	6.9	4.7	2.3	1.3	0.7
100	44.4	29.2	18.3	10.7	7.9	5.3	2.6	1.4	0.8
100+5%	46.6	30.7	19.2	11.2	8.3	5.6	2.7	1.5	0.8
100+10%	48.8	32.1	20.1	11.8	8.7	5.8	2.8	1.6	0.9
100+20%	53.2	35.0	21.9	12.8	9.4	6.3	3.1	1.7	0.9
100+30%	57.7	38.0	23.7	13.9	10.2	6.9	3.3	1.9	1.0
100+40%	62.1	40.9	25.6	15.0	11.0	7.4	3.6	2.0	1.1

Table 2 – Existing Surface Water Runoff Volume (m³)

	Storm Durations (hr)								
	0.25	0.5	1	2	3	5	12	24	48
1	9.6	12.3	15.2	22.0	26.3	31.8	41.2	49.4	59.8
2	13.8	17.5	21.6	29.3	34.3	40.4	50.4	59.3	70.2
5	19.4	25.0	30.9	39.4	45.0	52.1	63.0	72.7	84.3
10	24.0	30.9	38.3	47.3	53.5	61.2	73.1	83.1	95.3
30	31.3	40.8	50.8	60.7	67.7	76.3	89.8	100.6	113.4
50	34.9	45.7	57.0	67.3	74.7	83.9	98.2	109.5	122.5
100	39.9	52.6	65.7	76.9	85.0	95.2	111.2	123.4	136.3
100+5%	41.9	55.2	69.0	80.8	89.3	100.0	116.7	129.5	143.1
100+10%	43.9	57.8	72.3	84.6	93.5	104.7	122.3	135.7	149.9
100+20%	47.9	63.1	78.9	92.3	102.0	114.3	133.4	148.0	163.5
100+30%	51.9	68.3	85.4	100.0	110.5	123.8	144.5	160.4	177.1
100+40%	55.9	73.6	92.0	107.7	119.0	133.3	155.7	172.7	190.8

Proposed Surface Water Runoff Rates

- 1.4 Post-development, the site will consist of approximately 1542m² of impermeable area and 48m² of soft landscaping. Tables 3 and 4 below show the surface water runoff rates and volumes generated post-development, if no mitigation was proposed.

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

	Storm Durations (hr)								
	0.25	0.5	1	2	3	5	12	24	48
1	10.4	6.7	4.1	3.0	2.4	1.7	0.9	0.6	0.3
2	15.0	9.5	5.9	4.0	3.1	2.2	1.1	0.7	0.4
5	21.1	13.6	8.4	5.4	4.1	2.8	1.4	0.8	0.5
10	26.1	16.8	10.4	6.4	4.9	3.3	1.7	0.9	0.5
30	34.0	22.2	13.8	8.3	6.1	4.1	2.0	1.1	0.6
50	37.9	24.8	15.5	9.2	6.8	4.6	2.2	1.2	0.7
100	43.4	28.6	17.9	10.5	7.7	5.2	2.5	1.4	0.8
100+5%	45.6	30.0	18.8	11.0	8.1	5.4	2.6	1.5	0.8
100+10%	47.8	31.4	19.7	11.5	8.5	5.7	2.8	1.5	0.8
100+20%	52.1	34.3	21.4	12.6	9.2	6.2	3.0	1.7	0.9
100+30%	56.4	37.2	23.2	13.6	10.0	6.7	3.3	1.8	1.0
100+40%	60.8	40.0	25.0	14.6	10.8	7.2	3.5	2.0	1.1

Table 4 – Proposed Surface Water Runoff Volume (m³)

	Storm Durations (hr)								
	0.25	0.5	1	2	3	5	12	24	48
1	9.4	12.0	14.9	21.5	25.7	31.1	40.4	48.4	58.5
2	13.5	17.2	21.2	28.7	33.6	39.5	49.4	58.0	68.7
5	19.0	24.4	30.2	38.5	44.1	51.0	61.7	71.2	82.5
10	23.5	30.2	37.5	46.3	52.4	59.9	71.6	81.4	93.3
30	30.6	39.9	49.8	59.4	66.2	74.7	87.9	98.4	111.0
50	34.2	44.7	55.8	65.9	73.1	82.1	96.2	107.2	119.9
100	39.1	51.4	64.3	75.3	83.2	93.2	108.8	120.8	133.4
100+5%	41.0	54.0	67.6	79.1	87.4	97.9	114.3	126.8	140.1
100+10%	43.0	56.6	70.8	82.9	91.6	102.5	119.7	132.8	146.7
100+20%	46.9	61.7	77.2	90.4	99.9	111.8	130.6	144.9	160.1
100+30%	50.8	66.9	83.6	97.9	108.2	121.2	141.5	157.0	173.4
100+40%	54.7	72.0	90.1	105.4	116.5	130.5	152.4	169.1	186.7

Appendix H

MicroDrainage Modelling Assessment

RPS Group PLC		Page 1
Suite D10 Josephs Well Leeds LS3 1AB	HLEF 71415 CAVERSHAM ROAD ICP SUDS	
Date 16/08/2019 13:49 File CAVERSHAM MODEL ST 16.0...	Designed by ST Checked by RR	
Micro Drainage Source Control 2017.1.2		

ICP SUDS Mean Annual Flood

Input

Return Period (years)	100	Soil	0.150
Area (ha)	0.159	Urban	0.000
SAAR (mm)	700	Region Number	Region 6

Results 1/s

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

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RPS Group PLC

Suite D10 Josephs Well
Leeds
LS3 1AB

HLEF 71415
Caversham Road

Date 16/08/2019 13:13
File Caversham model ST 16.0...

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Micro Drainage

Source Control 2017.1.2

Page 1



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

Half Drain Time : 406 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	37.261	0.551	0.0	1.6	1.6	36.6	O K
30 min Summer	37.431	0.721	0.0	1.6	1.6	47.9	O K
60 min Summer	37.591	0.881	0.0	1.6	1.6	58.6	O K
120 min Summer	37.720	1.010	0.0	1.8	1.8	67.2	O K
180 min Summer	37.774	1.064	0.0	1.8	1.8	70.2	Flood Risk
240 min Summer	37.787	1.077	0.0	1.8	1.8	70.9	Flood Risk
360 min Summer	37.755	1.045	0.0	1.8	1.8	69.5	O K
480 min Summer	37.730	1.020	0.0	1.8	1.8	67.8	O K
600 min Summer	37.703	0.993	0.0	1.7	1.7	66.0	O K
720 min Summer	37.676	0.966	0.0	1.7	1.7	64.2	O K
960 min Summer	37.622	0.912	0.0	1.7	1.7	60.7	O K
1440 min Summer	37.522	0.812	0.0	1.6	1.6	54.0	O K
2160 min Summer	37.383	0.673	0.0	1.6	1.6	44.8	O K
2880 min Summer	37.231	0.521	0.0	1.6	1.6	34.7	O K
4320 min Summer	37.004	0.294	0.0	1.6	1.6	19.5	O K
5760 min Summer	36.889	0.179	0.0	1.6	1.6	11.9	O K
7200 min Summer	36.830	0.120	0.0	1.5	1.5	8.0	O K
8640 min Summer	36.800	0.090	0.0	1.4	1.4	6.0	O K
10080 min Summer	36.787	0.077	0.0	1.2	1.2	5.2	O K
15 min Winter	37.331	0.621	0.0	1.6	1.6	41.3	O K

Storm Event	Rain (mm/hr)	Flooded Volume (m³)	Discharge Volume (m³)	Time-Peak (mins)
15 min Summer	131.351	0.0	38.1	26
30 min Summer	86.314	0.0	50.4	40
60 min Summer	54.074	0.0	63.5	68
120 min Summer	32.762	0.0	77.2	126
180 min Summer	24.128	0.0	85.3	184
240 min Summer	19.312	0.0	91.1	242
360 min Summer	14.018	0.0	99.2	320
480 min Summer	11.175	0.0	105.5	382
600 min Summer	9.366	0.0	110.5	446
720 min Summer	8.105	0.0	114.8	514
960 min Summer	6.446	0.0	121.7	654
1440 min Summer	4.660	0.0	131.9	930
2160 min Summer	3.364	0.0	142.8	1344
2880 min Summer	2.667	0.0	150.7	1732
4320 min Summer	1.920	0.0	162.3	2384
5760 min Summer	1.519	0.0	170.9	3056
7200 min Summer	1.266	0.0	177.7	3744
8640 min Summer	1.090	0.0	183.3	4408
10080 min Summer	0.961	0.0	188.0	5144
15 min Winter	131.351	0.0	42.8	26

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Micro Drainage		Source Control 2017.1.2

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)	19.100	Shortest Storm (mins)	15
Ratio R	0.400	Longest Storm (mins)	10080
Summer Storms	Yes	Climate Change %	+40

Time Area Diagram

Total Area (ha) 0.159

Time (mins)	Area	Time (mins)	Area	Time (mins)	Area
From: To: (ha)	From: To: (ha)	From: To: (ha)			
0 4 0.053	4 8 0.053	8 12 0.053			

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Micro Drainage Source Control 2017.1.2		

Model Details

Storage is Online Cover Level (m) 38.060

Complex Structure

Cellular Storage

Invert Level (m) 36.710 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000 Porosity 0.95
Infiltration Coefficient Side (m/hr) 0.00000

Depth (m)	Area (m ²)	Inf. Area (m ²)	Depth (m)	Area (m ²)	Inf. Area (m ²)
0.000	70.0	0.0	1.051	0.0	0.0
1.050	70.0	0.0			

Porous Car Park

Infiltration Coefficient Base (m/hr)	0.00000	Width (m)	17.0
Membrane Percolation (mm/hr)	1000	Length (m)	10.0
Max Percolation (l/s)	47.2	Slope (1:X)	800.0
Safety Factor	2.0	Depression Storage (mm)	5
Porosity	0.30	Evaporation (mm/day)	3
Invert Level (m)	37.760	Membrane Depth (m)	0

Hydro-Brake® Optimum Outflow Control

Unit Reference	MD-SHE-0062-2000-1350-2000
Design Head (m)	1.350
Design Flow (l/s)	2.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	62
Invert Level (m)	36.710
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.350	2.0
Flush-Flo™	0.274	1.6
Kick-Flo®	0.557	1.3
Mean Flow over Head Range	-	1.6

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

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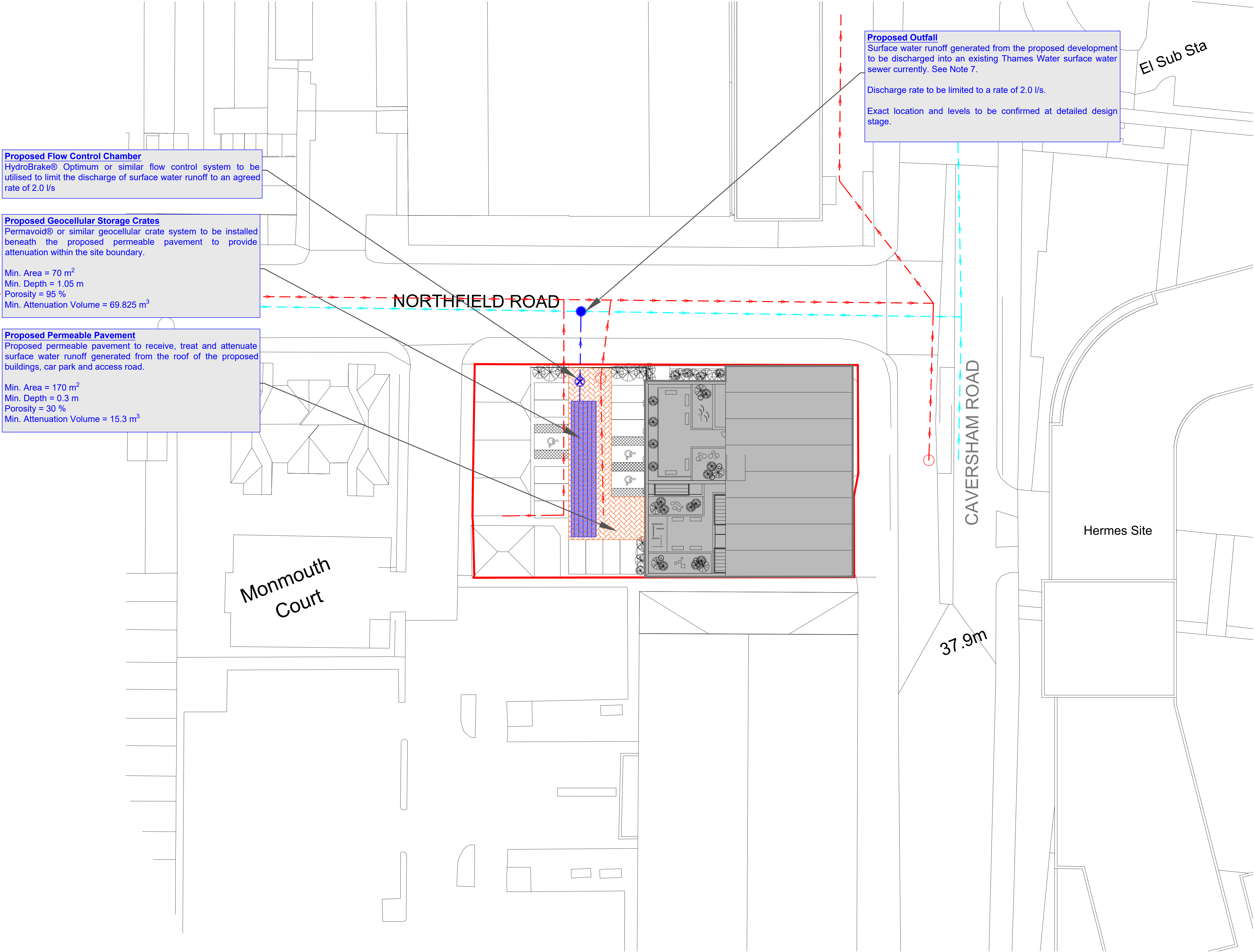
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Date 16/08/2019 13:13 File Caversham model ST 16.0...	Designed by ST Checked by RR	
Micro Drainage		Source Control 2017.1.2

Hydro-Brake® Optimum Outflow Control

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.4	1.200	1.9	3.000	2.9	7.000	4.3
0.200	1.6	1.400	2.0	3.500	3.1	7.500	4.4
0.300	1.6	1.600	2.2	4.000	3.3	8.000	4.6
0.400	1.6	1.800	2.3	4.500	3.5	8.500	4.7
0.500	1.5	2.000	2.4	5.000	3.7	9.000	4.8
0.600	1.4	2.200	2.5	5.500	3.8	9.500	4.9
0.800	1.6	2.400	2.6	6.000	4.0		
1.000	1.7	2.600	2.7	6.500	4.1		

Appendix I

Conceptual Surface Water Drainage Layout



Proposed Flow Control Chamber
HydroBrake® Optimum or similar flow control system to be utilised to limit the discharge of surface water runoff to an agreed rate of 2.0 l/s

Proposed Geocellular Storage Crates
Permavoid® or similar geocellular crate system to be installed beneath the proposed permeable pavement to provide attenuation within the site boundary.

Min. Area = 70 m²
Min. Depth = 1.05 m
Porosity = 95 %
Min. Attenuation Volume = 69.825 m³

Proposed Permeable Pavement
Proposed permeable pavement to receive, treat and attenuate surface water runoff generated from the roof of the proposed buildings, car park and access road.

Min. Area = 170 m²
Min. Depth = 0.3 m
Porosity = 30 %
Min. Attenuation Volume = 15.3 m³

Proposed Outfall
Surface water runoff generated from the proposed development to be discharged into an existing Thames Water surface water sewer currently. See Note 7.

Discharge rate to be limited to a rate of 2.0 l/s.

Exact location and levels to be confirmed at detailed design stage.

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- 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. No dimensions are to be scaled from this drawing.
 3. Drawing is based on *Caversham Road, Reading- Proposed Masterplan MP02-01662.dwg* provided by JTP Studios.
 4. Surface water drainage strategy shown is outline and conceptual only. A detailed drainage strategy will need to be provided at the next design stage and prior to any construction on site.
 5. Surface water drainage strategy design to convey and store runoff generated by rainfall event of up to 1 in 100 year + 40% Climate Change.
 6. Attenuation and treatment of surface water runoff to be provided via proposed permeable pavement and geocellular storage crates. Dimensions and construction details to be confirmed at detailed design stage.
 7. Drawing design is based on a topographical survey completed by ASP on Feb 2019, surface water runoff generated on site currently is assumed to discharge into the existing Thames Water (TW) surface water sewer. It has been agreed with TW that surface water runoff generated on site is to be discharged into the existing TW sewer at a rate of 2.0 l/s.
 8. Further investigations required to confirm location and levels of the existing surface water drainage network at detailed design stage.

- Key
- Site Extent
 - Proposed Structures/Buildings
 - Proposed Permeable Pavement
 - Proposed Geocellular Storage Crates
 - Proposed Surface Water Drainage
 - Existing Thames Water Surface Water Sewer
 - Existing Thames Water Foul Water Sewer

A	For Planning	ST	RR	16.08.19
Rev	Description	By	CB	Date



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Client **S2 ESTATES**

Project **Caversham Road, Reading**

Title **Outline Surface Water Drainage Layout**

Status	Drawn By	PM/Checked by
For Planning	ST	RR

Project Number	Scale @ A1	Date Created
HLEF71415	1:250	16.08.2019

RPS Drawing / Figure Number	Rev
HLEF71415-D001	A

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Appendix J

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 approximately 170m² of permeable paving and underground attenuation crates capable of storing a total of 85m³ at the site. These measures have been shown to reduce surface water run-off rates to the lowest practical minimum discharge rate. 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
Permeable paving	 Permeable surfacing is formed of material that is itself impervious to water but, by virtue of voids formed through the surface, allows infiltration through the pattern of voids. The water can be temporarily stored before infiltration to the ground, reused, or discharged to a watercourse or other drainage system. Surfaces with an aggregate sub-base can provide good water quality treatment.	Brushing and vacuuming the paving to remove any obstructions	4 monthly	Can be undertaken by residents / management time as part of landscape maintenance
		Stabilise and mow contributing areas and removal of weeds	Monthly, or as deemed necessary	As above
		Remedial work to any depressions or broken blocks	When required	c. £500 - £1000
		Rehabilitation of surface and upper sub-structure where significant clogging occurs	When required	c. £500 - £1000
		Replacement of filter material	Every 20-25 years	c. £3,000 - £5,000

Type of SuDS	Illustration	Maintenance Required	Regularity	Indicative Cost
		Indicative annual maintenance cost - £0.5 - £1 / m ³ of storage volume		
Underground Attenuation Tank	 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 K

Confirmation of Drainage Maintenance and Ownership

S2 Caversham Limited
15 Half Moon Street, London, W1J 7DZ

Lead Local Flood Authority
Reading Borough Council,
Civic Offices,
Bridge Street,
Reading
RG1 2LU

Dear Sir/Madam

Re: 71-73 Caversham Road, Reading – Drainage Maintenance

We are currently the registered owner of the above-mentioned property.

We write to confirm that on completion of building works during the management of this property we assure that all drainage will be managed and maintained within the site boundary of this property.

I trust you will find this entirely satisfactory however should you have any questions please don't hesitate to contact me.

Yours Sincerely,



Sam Berg

Director

Company Number: 11820154

Vat Registration: 319 1902 09