STM environmental

ENVIRONMENTAL CONSULTING , SOFTWARE & TRAINING

FLOOD RISK ASSESSMENT

Site Address
Meadows Hall
Church Road
Richmond
TW10 6LN

Client
RHP

Date
08/09/2020

1 Document Control

FLOOD RISK ASSESSMENT

Site Address:	Meadows Hall Church Road Richmond TW10 6LN
National Grid Reference:	518393, 174939
STM Reference:	FRA – 2020 – 000090
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Contents

2 Abbreviations

Abbreviation	Description
STM	STM Environmental Consultants Limited
BGS	British Geological Survey
EA	Environment Agency
OS	Ordnance Survey of Great Britain
FRA	Flood Risk Assessment
NPPF	National Planning Policy Framework
FWD	Floodline Warning Direct
FRMS	Flood Risk Management Strategy
LBR	London Borough of Richmond upon Thames
SWMP	Surface Water Management Plan
SFRA	Strategic Flood Risk Assessment
CDA	Critical Drainage Area
SuDS	Sustainable Drainage Systems
GWSPZ	Groundwater Source Protection Zone
LLFA	Lead Local Flood Authority
mbgl	metres below ground level
DCLG	Department for Communities and Local Government
PPGPS	Planning practice guidance and Planning system

3 Disclaimer

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4 Executive Summary

Location	Meadows Hall, Church Road, Richmond, TW10 6LN Grid reference: 518393, 174939
Proposed Development	Redevelopment of the site from a former demolished day centre to 13 residential units.
Flood Zone	Flood Zone 1.
Topography	14.5mAOD to 16mAOD.
Sequential and Exception Tests	Development is non-minor and more vulnerable, however, due to the site location within flood zone 1, Sequential and Exception Tests should not be required. LLFA to decide.
Main Sources of Flooding	Surface Water.
Flood Defences	None.
Records of Historic Flooding	None.
Fluvial (River) and Tidal (Sea) Flood Risk	Low – Site lies within flood zone 1; No significant fluvial/tidal flooding incidents identified.
Pluvial (Surface Water) Flood Risk	Low – Site will remain dry during both the 1 in 30-year and the 1 in 100-year event. No significant surface water flooding incidents identified. Only 1 to 5 recorded sewer flooding incidents.
Flood Risk from Artificial (Canals and Reservoirs) Sources	Low – No significant artificial sources identified.
Groundwater Flood Risk	Low – Site is not potentially susceptible to groundwater flooding; no recorded incidents have been identified.
Development Impacts on Local Flood Risk	The development will not significantly increase the site impermeable area. As such it is unlikely to have an adverse impact on local flood risk.
Proposed Flood Risk Mitigation Measures	• Finished floor levels will be set to 300mm above ground levels; • Construction will utilise flood resistant materials and services will be placed as high as practicable to reduce impact of flooding; • Occupants will sign up for EA Emergency Flood Warning Direct Service; • Safe egress to flood zone 1 is available within the site boundary.
Surface Water Management (SuDS)	SuDS would reduce current surface water runoff rates. Consideration should be given to soakaways, rainwater harvesting and permeable paving where possible.
Conclusions	Based on the information reviewed and taking into account the proposed mitigation measures, it is considered that overall flood risk to the proposed development is low. With the implementation of an appropriate SuDS strategy, the proposal is unlikely to have an adverse impact on local flood risk. A basement impact assessment may be required.

5 Introduction

STM Environmental Consultants Limited (STM) has been appointed by RHP (Client) to provide a Flood Risk Assessment (FRA) at a site located at Meadows Hall, Church Road, Richmond, TW10 6LN.

6 Development Proposal

The FRA is required to support a planning application for the redevelopment of the site from a former demolished day centre to 13 residential units.

Further details including drawings of the development plans are available in Appendix 2.

7 Report Aims and Objectives

The purpose of this report is to establish the flood risk to the site from all potential sources and, where possible, to propose suitable mitigation methods to reduce any risks to an acceptable level. It aims to make an assessment of whether the development will be safe for its lifetime, taking into account climate change and the vulnerability of its users, without increasing flood risk elsewhere.

The FRA assesses flood risk to the site from tidal, fluvial, surface water, groundwater, sewers and artificial sources. The FRA has been produced in accordance with the National Planning Policy Framework (NPPF) and its supporting guidance.

8 Summary of Data Review Undertaken

The following research has been undertaken as part of the FRA:

- Desktop assessment of topographical, hydrological and hydrogeological settings through review of the information sourced from the British Geological Survey (BGS), the Environment Agency (EA) and the Ordnance Survey (OS);
- Review of publicly available flood risk mapping provided by the EA;
- Review of the Preliminary Flood Risk Assessment (PFRA) and Level 1 Strategic Flood Risk Assessment (SFRA) produced by the LLFA outlining flood risk from various sources within the borough.

9 Legislative and Policy Context

9.1 Legislative Context

The Flood and Water Management Act was introduced in 2010. The Act defines the role of lead local flood authority (LLFA) for an area. All LLFA are required to develop, maintain, apply and monitor a strategy for local flood risk management in its area, called “local flood risk management strategy”.

Alongside the Act, Flood Risk Regulations (2009) outline the roles and responsibilities of the various authorities, which include preparing Flood Risk Management Plans and identifying how significant flood risks are to be mitigated.

9.2 Policy Context

9.2.1 National Planning Policy Framework (NPPF)

The NPPF sets out the government’s planning policies for England and how these are expected to be applied. It also provides a set of guidelines and philosophy with which local planning authorities (LPAs) can build their own unique policies to appropriately regulate development within their jurisdictions.

Section 14 entitled “Meeting the challenge of climate change, flooding and coastal change” deals specifically with flood risk. Among other things it states that LPAs

should try to ensure that “Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk (whether existing or future). Where development is necessary in such areas, the development should be made safe for its lifetime without increasing flood risk elsewhere”. It further states that when determining planning application, LPAs should “ensure that flood risk is not increased elsewhere. Where appropriate, applications should be supported by a site-specific flood-risk assessment. Development should only be allowed in areas at risk of flooding where, in the light of this assessment (and the sequential and exception tests, as applicable) it can be demonstrated that:

- within the site, the most vulnerable development is located in areas of lowest flood risk, unless there are overriding reasons to prefer a different location;
- development is appropriately flood resilient and resistant;
- it incorporates sustainable drainage systems, unless there is clear evidence that this would be inappropriate;
- any residual risk can be safely managed; and
- safe access and escape routes are included where appropriate, as part of an agreed emergency plan.

Applications for minor development and changes of use should not be subject to the Sequential or Exception Tests but should still meet the requirements for site-specific flood risk assessments set out in footnote 50.

Footnote 50 states: “A site-specific flood risk assessment should be provided for all development in Flood Zones 2 and 3. In Flood Zone 1, an assessment should accompany all proposals involving: sites of 1 hectare or more; land which has been identified by the Environment Agency as having critical drainage problems; land identified in a strategic flood risk assessment as being at increased flood risk in future; or land that may be subject to other sources of flooding, where its development would introduce a more vulnerable use.”

The NPPF also lays out requirements for how LPAs should deal with planning applications in coastal areas. They should ensure that should they "reduce risk from coastal change by avoiding inappropriate development in vulnerable areas or adding to the impacts of physical changes to the coast."

Developments in Coastal Change Management Areas should only be considered appropriate where it is demonstrated that:

- it will be safe over its planned lifetime and will not have an unacceptable impact on coastal change;
- the character of the coast including designations is not compromised;
- the development provides wider sustainability benefits;
- the development does not hinder the creation and maintenance of a continuous signed and managed route around the coast.

9.2.2 Local Planning Policy

The Core Strategy states that development will need to be designed to take account of the impacts of climate change over its lifetime, including:

- Water conservation and drainage
- The need for Summer cooling
- Risk of subsidence
- Flood risk from the River Thames and its tributaries

Development in areas of high flood risk will be restricted, in accordance with PPS25, and using the Environment Agency's Catchment Flood Management Plan, Borough's Strategic Flood Risk Assessment and site level assessments to determine risk.

9.3 EA Standing Advice on Flood Risk

The Environment Agency's standing advice lays out the process that must be followed when carrying out flood risk assessments for developments.

Flood risk assessments are required for developments within one of the flood zones.

This includes developments:

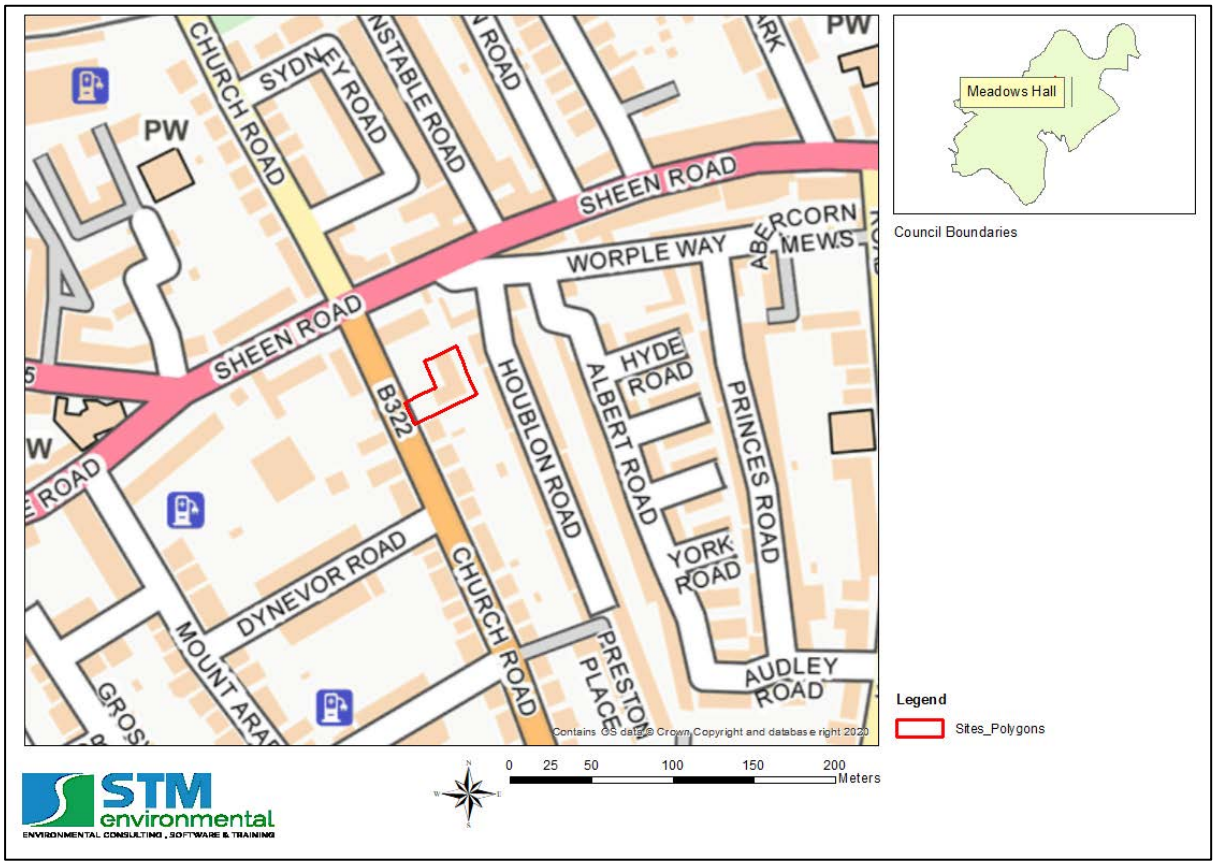
- in flood zone 2 or 3 including minor development and change of use more than 1 hectare (ha) in flood zone 1;
- less than 1 ha in flood zone 1, including a change of use in development type to a more vulnerable class (for example from commercial to residential), where they could be affected by sources of flooding other than rivers and the sea (for example surface water drains, reservoirs);
- in an area within flood zone 1 which has critical drainage problems as notified by the Environment Agency.

10 Site Description and Environmental Characteristics

10.1 Site Location and Area

The site is located at Meadows Hall, Church Road, Richmond, TW10 6LN. It is centred at national grid reference 518393, 174939. The site has an area of approximately 1000m^2.

A site location map and aerial photo are shown below. Photographs of the site are available in Appendix 1.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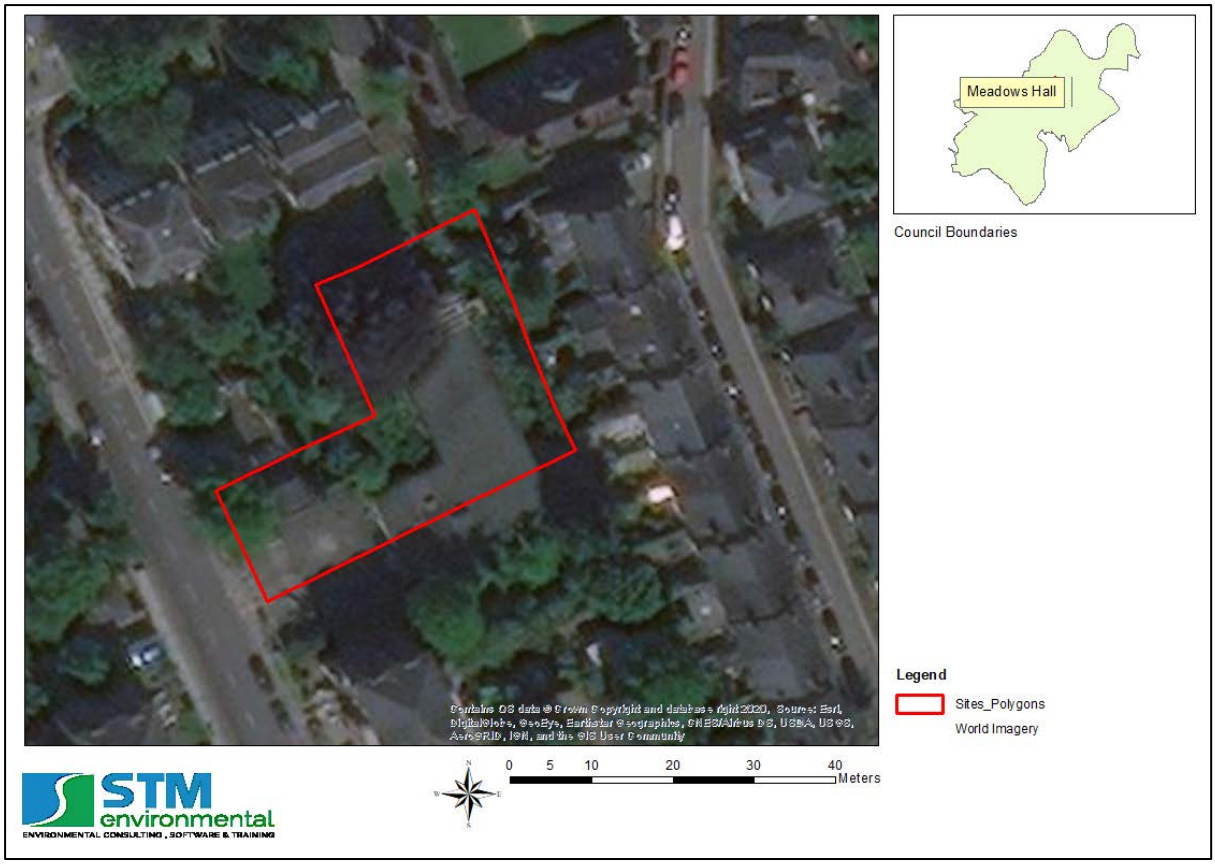
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10.2 Site Access

The site is accessed via Church Road.

10.3 Local Planning Authority

The site falls within the jurisdiction of London Borough of Richmond upon Thames in terms of the planning process.

10.4 Lead Local Flood Authority

London Borough of Richmond upon Thames is also the Lead Local Flood Authority (LLFA).

10.5 Flood Zone

For planning purposes, the site is located in Flood Zone 1 as defined by the EA and LLFA.

10.6 Site and Surrounding Land Uses

10.6.1 Site Current Land Use

The site is currently vacant, cleared and ready for development. The former Day Centre was demolished in 2018 following consultation which deemed the facility surplus to requirements.

10.6.2 Surrounding Land Uses

The land use surrounding the site is mainly residential and commercial.

10.7 Hydrology

The nearest main watercourse is the River Thames which is located 760m to the South-West of the site.

10.8 Geology

Data from the British Geological Survey indicates that the underlying bedrock geology is characterized as London Clay Formation. No superficial deposits were identified.

10.9 Hydrogeology

The site lies upon an unproductive bedrock aquifer.

Appendix 3 provides BGS mapping showing the hydrogeology at the site location.

10.10 Topography

A LIDAR map showing the topology of the site and surrounding area is available in Appendix 3. The ground level at the site ranges from 14.5mAOD in the North to 16mAOD. At the majority of the site, the ground level ranges from 15.8mAOD to 16mAOD.

A topographic survey has not been conducted.

11 The Sequential and Exception Tests

11.1 The Sequential Test

The Sequential Test aims to steer developments and redevelopments to areas of lower flood risk. The test compares the proposed development site with other available sites, in terms of flood risk, to aid the steering process. The Sequential Test is not required if the proposed development is a minor development or if it involves a change of use unless the development is a caravan, camping chalet, mobile home or park home site.

Minor development means:

- minor non-residential extensions: industrial/commercial/leisure etc extensions with a footprint less than 250 square metre.
- alterations: development that does not increase the size of buildings eg alterations to external appearance.

- householder development: For example; sheds, garages, games rooms etc within the curtilage of the existing dwelling, in addition to physical extensions to the existing dwelling itself. This definition excludes any proposed development that would create a separate dwelling within the curtilage of the existing dwelling eg subdivision of houses into flats.

The development is not considered to be minor. However, due to its location within flood zone 1, the Sequential Test should not be required by the LLFA.

11.2 The Exception Test

If alternative sites of lower flood risk are not available then the proposed development may require an Exception Test to be granted planning permission. Where the exception test is required, it should be applied as soon as possible to all local development document allocations for developments and all planning applications other than for minor developments. All three elements of the exception test have to be passed before development is allocated or permitted. For the exception test to be passed:

- It must demonstrate that the development provides wider sustainability benefits to the community that outweigh the flood risk, informed by an SFRA, where one has been prepared;
- The development should be on developed land or on previously developed land;
- A flood risk assessment must demonstrate that the development will be safe without increasing flood risk elsewhere, and where possible will reduce the overall flood risk.

The requirements for an Exception Test are given in Table 2 and are defined in terms of Flood Zone and development vulnerability classification.

Table 1: NPPF flood zone vulnerability compatibility (source: NPPF).

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

Key:

✓ Development is appropriate

✗ Development should not be permitted.

Based on its scale and nature, the development is considered to be “more vulnerable”. As such the Exception Test should not be required by the LLFA.

12 Site Specific Flood Risk Analysis

The PFRA and Level 1 SFRA produced by the LLFA and maps from the EA provide information regarding historic flooding events and incidents as well as predictions of flood extents and depths during extreme rainfall events.

12.1 Fluvial (River) and Tidal (Sea) Flood Risk

12.1.1 Mechanisms for Fluvial Flooding

Fluvial, or river flooding, occurs when excessive rainfall over an extended period of time or heavy snow melt causes a river to exceed its capacity. The damage from a fluvial flood can be widespread as the overflow may affect downstream tributaries, overtopping defences and flooding nearby inhabited areas. Fluvial flooding consists of two main types:

- Overbank flooding – this occurs when water rises steadily and overflows over the edges of a river or stream;
- Flash flooding – this is characterized by an intense, high velocity torrent of water that occurs in an existing river channel with little to no notice. Flash floods are very dangerous and destructive not only because of the force of the water, but also the hurtling debris that is often swept up in the flow.

12.1.2 Definition of EA Modelled Fluvial Flood Risk Zones

Fluvial flood risk is assessed using flooding maps produced by the Environment Agency. These maps use available historic data and hydraulic modelling to define zones of flood risk. The maps allow a site to be defined in terms of its flood zone (e.g. 1, 2, 3) and in terms of the overall flood risk (very low, low, medium or high). It is important to note that existing flood defences are not taken into account within the models or the maps. The EA fluvial flood zones are defined as follows:

- Flood zone 1: Less than 1 in 1000 (0.1%) annual probability of flooding;
- Flood zone 2: Between 1 in 100 (1%) and 1 in 1000 (0.1%) annual probability of flooding;
- Flood zone 3: Greater than 1 in 100 (1%) annual probability of fluvial flooding.

Flood zone 3 is split into two sub-categories (3a and 3b) by LLFAs depending on whether the land is considered to be a functional flood plain (i.e. an important storage area for flood waters in extreme events).

- Flood zone 3a: Greater than 1 in 100 (1%) annual probability of fluvial flooding and/or greater than 1 in 200 (0.5%) annual probability of tidal flooding;
- Flood zone 3b: Functional flood plain (definition specific to the LLFA). Less than a 1 in 20 (5%) annual probability of fluvial and/or tidal flooding.

12.1.3 Main Potential Sources of Local Fluvial Flooding

The nearest potential source of fluvial flooding to the site is considered to be the River Thames.

12.1.4 Records of Historic Fluvial Flooding Incidents

The EA informed that they do not have any information on recorded flood incidents in the vicinity of the site.

12.1.5 Designated Fluvial Flood Risk Zone for the Site

The site is considered to be located within flood zone 1 as defined by the Environment Agency and the LLFA indicating that it has less than 1 in 1000 annual probability of fluvial flooding.

12.1.6 Mechanisms for Tidal Flooding

Tidal flooding may be described simply as the inundation of low-lying coastal areas by the sea, or the overtopping or breaching of sea defences. Tidal flooding may be caused by seasonal high tides, storm surges and where increase in water level above the astronomical tide level is created by strong on shore winds or by storm driven wave action.

12.1.7 Definition of EA Tidal Flood Risk Zones

As with fluvial flood risk, tidal flood risk is assessed using flooding maps produced by the Environment Agency. The difference is in the probability return periods used to define tidal flood zones. The EA tidal flood zones are defined as:

- Flood zone 1: Less than 1 in 1000 (0.1%) annual probability of flooding;
- Flood zone 2: Between 1 in 200 (0.5%) and 1 in 1000 (0.1%) annual probability of tidal flooding;
- Flood zone 3: Greater 1 in 200 (0.5%) annual probability of tidal flooding.

12.1.8 Potential Sources of Tidal Flooding

The area in which the site is located is considered unlikely to be affected by tidal flooding.

12.1.9 Flood Defences

The EA's Areas benefitting from flood defences and current flood defences map shows that the site benefits from flood defences.

12.1.10 Climate Change - EA Modelled Predictions of Fluvial and Tidal Flood Levels and Extents

As the site is located within flood zone 1, no modelled flood levels are available as the site will remain dry during all modelled events.

12.1.11 Long Term Fluvial Flood Risk Considering Flood Defences

The EA's long term flood risk maps give an indication of the actual risk associated with flooding after taking into account the effect of any flood defences in the area. Copies of maps for the site which are available in Appendix 8 indicate that the long-term risk from fluvial flooding to the site is very low.

12.2 Pluvial (Surface Water) Flood Risk

A pluvial, or surface water flood, is caused when heavy rainfall creates a flood event independent of an overflowing water body. Surface water flooding occurs when high intensity rainfall leads to run-off which flows over the ground surface, causing ponding in low-lying areas when the precipitation rate or overland flow rate is greater than the rate of infiltration, or return into watercourses. Surface water flooding can be exacerbated when the underlying soil and geology is saturated (as a result of prolonged precipitation or a high-water table) or when the drainage network has insufficient capacity.

12.2.1 Mechanisms of Pluvial Flooding

The chief mechanisms for surface water flooding can be divided into the following categories:

- Runoff from higher topography;
- Localised surface water runoff – as a result of localised ponding of surface water;
- Sewer Flooding – areas where extensive and deep surface water flooding is likely to be influenced by sewer flooding. Where the sewer network has reached capacity, and surcharged, this will exacerbate the flood risk in these areas;
- Low Lying Areas – areas such as underpasses, subways and lowered roads beneath railway lines are more susceptible to surface water flooding;
- Railway Cuttings –railway infrastructure cut into the natural geological formations can cause extra surface run off and pooling disrupting service and potentially affecting adjacent structures;
- Railway Embankments – discrete surface water flooding locations along the up-stream side of the raised network rail embankments where water flows are interrupted and ponding can occur;
- Failure of artificial sources (i.e. man-made structures) such as such as canals and reservoirs.

12.2.2 Main Potential Sources of Local Pluvial Flooding

The main potential source of pluvial flooding to the site is considered to be surface water ponding and flooding associated with heavy rainfall.

12.2.3 Records of Historic Pluvial Flooding Incidents

Examination of the LLFA's Level 1 SFRA revealed no evidence of records of pluvial flooding at the site.

A map showing the location of surface water flooding incidents is available in Appendix 4 .

12.2.4 Surface Water Flood Risk from Artificial Sources (Reservoirs and Canals)

An examination of OS mapping and the EA's mapping revealed no indications of significant reservoirs or canals in the area of the site.

The EA's reservoir flood risk map indicates that the site does not lie within an area that is at risk of reservoir flooding.

12.2.5 Sewer Flooding

A map showing recorded incidents of sewer flooding is available in Appendix 4.
In the postcode area TW106, only 1 to 5 sewer flooding incidents were recorded.

12.2.6 Climate Change - Modelled Predictions of Surface Water Run-off Flooding

Mapping of the predicted extent and depth of surface water flooding for the 1 in 30-year, 1 in 100-year and 1 in 1000-year rainfall return periods provided by the EA are available in Appendix 6.

The maps show that the site would remain dry during both the 1 in 30-year and the 1 in 100-year precipitation events. During the 1 in 1000-year event, the majority of the site will remain dry with only some localised pooling in the south west with depths up to 300mm.

12.2.7 Long Term Surface Water Flood Risk

The EA's long term flood risk maps which are available in Appendix 8 indicate that the long term risk of flooding from surface water is also considered to be very low.

12.3 Risk of Flooding from Multiple Sources (ROFMS)

The Environment Agency provides a map which gives an indication the overall flood risk from fluvial, tidal and surface water sources considering the presence of river defences. This map indicates that there is less than 0.1% chance of flooding at the majority of the site in any year. A small area to the south west has up to 1% chance of flooding yearly. A copy of the map is presented in Appendix 8.

12.4 Groundwater Flood Risk

Groundwater flooding occurs when water rises from the underlying aquifer at the location of a spring – where the underlying impermeable geology meets the ground surface. This tends to occur after much longer periods of intense precipitation, in often low-lying areas where the water table is likely to be at a shallow depth. Groundwater flooding is known to occur in areas underlain by principal aquifers, although increasingly it is also being associated with more localised floodplain sands and gravels. A high groundwater table also has the potential to exacerbate the risk of surface water and fluvial flooding by reducing rainfall infiltration capacity, and to increase the risk of sewer flooding through sewer/groundwater interactions.

12.4.1 Historic Records of Groundwater Flooding

A map showing the locations of historic groundwater flooding incidents is available in Appendix 4. The map indicates that there have been no recorded incidents of groundwater flooding at the site.

12.4.2 Susceptibility to Groundwater Flooding

The Groundwater Flood Susceptibility Map provided by BGS, which is available in Appendix 9 indicates that the potential for groundwater flooding to occur at the surface does not exist. The Groundwater Depth map also provided by BGS indicates that the groundwater level may be at greater than 5mbgl.

12.5 Critical Drainage Area

A Critical Drainage Area (CDA) may be defined as “a discrete geographic area (usually a hydrological catchment) where multiple and interlinked sources of flood risk (surface water, groundwater, sewer, main river and/or tidal) cause flooding in one or more Local Flood Risk Zones during severe weather thereby affecting people, property or local infrastructure”. A CDA is defined in the Town and Country Planning (General Development Procedure) (Amendment) (No. 2) (England) Order 2006 as “an area within Flood Zone 1 which has critical drainage problems and which has been notified… [to]…the local planning authority by the Environment Agency”.

The site is located within the Group8_004 Richmond Centre Critical Drainage Area.

13 Potential Impacts of the Development on Local Flood Risk

13.1 Impacts on Flood Storage

13.1.1 Changes to Impermeable Area and Building Footprint

The change to the impermeable area of the site is considered to be insignificant.

As the development will not significantly increase the site impermeable area, it is considered unlikely that it will impact upon surface water runoff rates.

Additionally, as it will not significantly increase the site's built up area and it is located within flood zone 1, it is unlikely to impact upon local flood storage.

13.2 Impacts on Flood Flow Routes

The proposal is unlikely to have a significant impact on flood flow paths.

14 Flood Risk Mitigation Measures

14.1 SuDS

Planning practice guidance (PPG) which is prepared by the Ministry of Housing, Communities and Local Government (DCLG) states that developers and Local Authorities should seek opportunities to reduce the overall level of flood risk in the area through the layout and form of the development, and the appropriate application of sustainable drainage techniques.

As such, the developer has to implement a SuDS strategy in line with the drainage hierarchy as outlined in Table 2 below to reduce surface water discharges from the site.

Table 2: SuDs Options

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

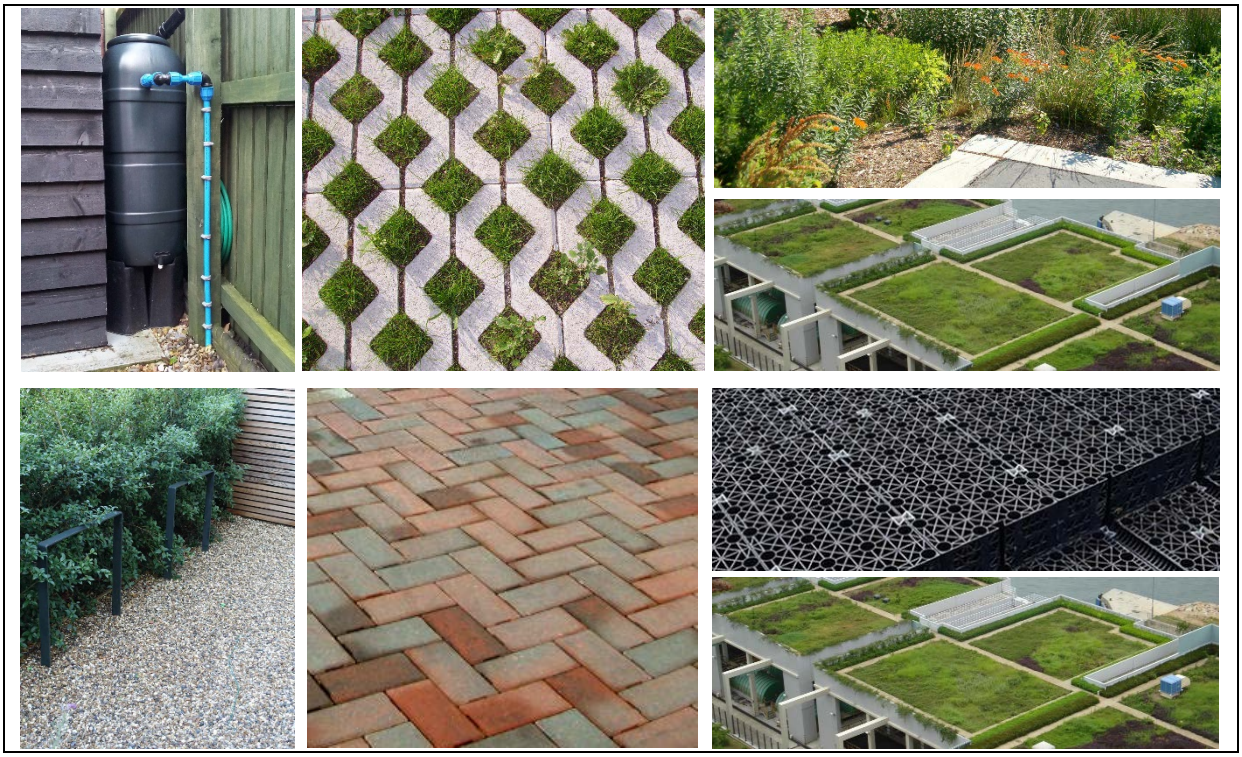


Figure 1: Surface water storage facilities and potential SuDS features - rainwater harvesting, on-site tank storage, rain garden soak-away and green roofs. (Source: UK SuDS Manual)

Given the nature of the development and the size of the site, it is considered that there are opportunities for implementing SuDS. Measures such as green roofs, rainwater harvesting, infiltration (soakaways, permeable paving, rain gardens) or

attenuation storage tanks should be considered. When required, the SuDS strategy will be detailed in a separate report as is outside the scope of works of this FRA.

14.2 Flood Resilience

Flood resilient construction uses methods and materials that reduce the impact from a flood, ensuring that structural integrity is maintained, and the drying out and cleaning required, following inundation and before reoccupation, is minimised.

14.2.1 Finished Floor Levels

For vulnerable developments**,** EA Standing Advice states that finished floor level of the lowest habitable room in any building Ground floor levels should be a minimum of 300millimetres (mm) above the general ground level of the site or 300mm above the estimated river or sea flood level whichever is higher.

As the site will remain dry during all modelled events, finished floor levels can be set to 300mm above general ground levels.

14.2.2 Flood displacement storage

All new development within Flood Zone 3 must not result in a net loss of flood storage capacity. Where possible, opportunities should be sought to achieve an increase in the provision of floodplain storage.

Where proposed development results in a change in building footprint, the developer must ensure that it does not impact upon the ability of the floodplain to store water, and should seek opportunities to provide a betterment with respect to floodplain storage.

As the site lies within flood zone 1, flood displacement storage is not considered to be required.

14.2.3 Flood Resilience Measures

In terms of achieving resilience, there are two main strategies, whose applicability is dependent on the water depth the property is subjected to. These are:

- Water exclusion strategy - where emphasis is placed on minimising water entry whilst maintaining structural integrity, and on using materials and construction techniques to facilitate drying and cleaning. This strategy is favoured when low flood water depths are involved (not more than 0.3m);
- Water entry strategy - buildings are at significant risk of structural damage if there is a water level difference between outside and inside of about 0.6m or more. This strategy is therefore favoured when high flood water depths are involved (greater than 0.6m).

Given that flood depths less than 0.3m are predicted in extreme scenarios, the water exclusion strategy is considered most applicable for this site.

Flood resilience design and measures that will be implemented are outlined below. Water-resistant and resilient materials will be utilized through the construction to minimize the flood risk and potential impacts.

Floor construction:

- Use of ceramic tiles or stone floor finishes is recommended;

Wall construction:

- Include in the external face of the extension a damp – proof course, 300 mm above ground level, to prevent damp rising through the wall;
- Use rigid closed – cell material for insulation above the DPC.

Doors:

- Seal doors around edges and openings. UPVC or composite material will be used with passive protection meaning that minimal intervention will be required in the event of flooding.

Basement walls, windows, doors and construction:

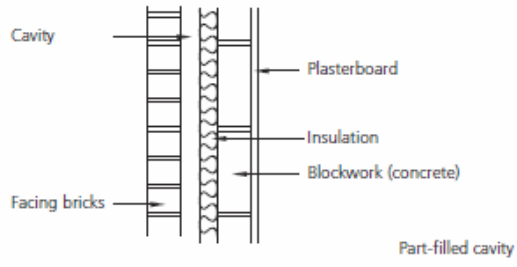
- The width of any visible basement wall should not dominate the original building;

- Windows should relate to the façade above and be aligned to the openings above; Moreover, their size must be subordinate to the higher-level openings;
- The basement development should provide an appropriate proportion of planted material to allow for rain water to be absorbed and/or to compensate for the loss of biodiversity caused by the development;
- A minimum of 1 metre of soil be provided above basement development that extends beyond the footprint of the building, to enable garden planting and to mitigate the effect on infiltration capacity.

Underground drainage:

- Avoid use of metal for any underground piping;
- Use closed cell insulation for pipes that are below the predicted flood level;
- Provide non – return valves for the drainage system to prevent back water flow;
- Use UPVC or clay pipework for fouls and surface water drainage.

Figure 6.10 Cavity External Walls – Part-filled cavity with sacrificial plasterboard



Part-filled cavity

- External face consisting of engineering bricks up to required level for flood protection (up to d.p.c.). Other external facing materials can be used above this level, but ensure transition is watertight.
- Rigid insulation
- Internal cement based render, preferably with lime content. Composition depends on masonry; the following mix is effective:

  1 cement : 6 sand: 1 lime on concrete blocks.
- Stainless steel wall ties should be used to minimise corrosion and consequent staining.
- Sacrificial plasterboard can be used, but it needs to be removed between ground floor to flood level. The board should be laid horizontally to make removal easier.

As well as the above the following flood resilience features should be applied as part of the development:

- Electrical sockets should be installed above flood level for the ground floor;
- Utility services such as fuse boxes, meters, main cables, gas pipes, phone lines and sockets will be positioned as high as practicable;
- All external openings for pipes or vents below 400mm to be sealed around pipe or vent with expanding foam and mastic.

14.3 Emergency Plan

The dangers associated with flood water to people are possible injury and/or death. This can occur as a result of drowning or being carried along by the waters into hard objects or vice versa.

The risk to life is largely a function of the depth and velocity of the floodwater as it crosses the floodplain. Fast flowing deep water that contains debris would represent the greatest hazard.

The assessment of danger to people from walking in floodwater is described in the Flood Risks to People guidance documents (FD2321_TR1 and FD2321_TR2) by DEFRA/EA. Danger can be estimated by the simple formula:

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

where, HR = (flood) hazard rating; d = depth of flooding (m); v = velocity of floodwaters (m/sec); and DF = debris factor.

As the proposal lies within flood zone 1, the flood hazard score is classified as low.

The use of a flood emergency plan is therefore sufficient for the proposed development. The key elements of the emergency plan are described below.

14.3.1 EA Flood Warnings Direct Service Subscription

The occupants will subscribe to the EA Flood Warnings Direct Service which is a free service offered by the EA providing flood warnings direct to people by telephone, mobile, email, SMS text message and fax. The EA aims to provide 2 hours' notice of flood, day or night, allowing timely evacuation of the site.

The agency operates a 24-hour telephone service on 0345 988 1188 that provides frequently updated flood warnings and associated floodplain information. In addition, this information can also be found at https://fwd.environment-agency.gov.uk/app/olr/home along with recommendations on what steps should be taken to prepare for floods, what to do when warnings are issued, and how best to cope with the aftermath of floods.

14.3.2 Access and Safe Egress

Safe egress to Flood Zone 1 is available within the site boundaries.

14.3.3 Safe Refuge

Basement and ground floor studios will not have access internally to upper floors. However, their location will remain dry during all modelled fluvial/tidal events and up to the 1 in 100-year surface water scenario.

15 Conclusions and Recommendations

This assessment has considered the potential risks to the application site associated with flooding from fluvial, tidal, surface water, artificial and groundwater sources and the potential impacts of climate change.

A review of LLFA's PFRA and SFRA as well as data provided by the EA was undertaken. The main findings of the review and assessment are provided below:

- The site is classified as a more vulnerable non minor development within flood zone 1 and is therefore unlikely to require sequential and exception tests to be undertaken;
- The main source of potential flooding to the site is surface water;
- The EA defines the site as being within flood zone 1;
- No records of fluvial, tidal, surface water, groundwater or artificial flooding incidents were identified at the site;
- The site is within a CDA. However, it is not in an area that has had a significant number of sewage flooding incidents;
- The development will not result in a significant change in the impermeable area of the site and therefore is unlikely to increase local flood risk;
- There is opportunity for implementing SuDS mitigation measures. Consideration should be given to use of soakaways, rainwater harvesting and/or permeable paving where possible;
- Flood resilient materials and construction methods will be used so as to ensure that the impacts of any potential flooding are minimised as much as possible;
- Occupants will subscribe to the EA Flood Warnings Direct Service;
- Safe egress to flood zone 1 is available within the site boundary.

Based on the information reviewed and taking into account the proposed mitigation measures, it is considered that overall flood risk to the proposed development is low.

With the implementation of an appropriate SuDS strategy, the proposal is unlikely to have an adverse impact on local flood risk. A basement impact assessment may be required.

16 References

1. Communities and Local Government - National Planning Policy Framework NPPF, March 2012.
2. Communities and Local Government - Planning Practice Guidance: Flood Risk and Coastal Change, Updated 06 March 2014.
3. Strategic Flood Risk Assessment – London Borough of Richmond upon Thames, updated 2016.
4. Core Strategy – London Borough of Richmond upon Thames, 2009.
5. Surface Water Management Plan – London Borough of Richmond upon Thames, 2011.
6. CIRIA, Defra, Environment Agency – UK SuDS Manual, 2015.
7. Greater London Authority – London Sustainable Drainage Action Plan, 2015.
8. Google Maps accessed September 20.