Reselton Properties Ltd
(through Dartmouth Project Management Services Ltd)

Flood Risk Assessment for The redevelopment of The Former Stag Brewery Mortlake London, SW14 7ET

Report K0685/2 (Rev 4)

May 2020

Prepared and submitted by

Hydro-Logic Services
(part of Hydro International Ltd)
18-20 West End Road,
Mortimer, Reading,
Berkshire RG7 3TF

T: 01189 331 325
F: 01189 331 486

enquiries@hydro-logic.co.uk

www.hydro-logic.co.uk

EXECUTIVE SUMMARY OF REPORT

This report documents work undertaken by Hydro-Logic Services for Reselton between 2016 and 2019 in relation to the proposed redevelopment of the former Stag Brewery site at Mortlake.

The purpose of the work was to:

- Provide guidance to the Project team on the issues of flood risk and drainage
- Prepare a Flood Risk Assessment (FRA) suitable for submission with the Planning Applications

The key outcomes of the work are summarised in Section 5 of this Report.

The work delivered the following outputs:

- This report, including
- Flood Emergency Plan (Appendix G)
- Drainage Strategy (submitted under separate cover).

This is Revision 4 of the FRA and reflects changes to the layout of the Scheme that have been finalised in 2020.

Contributors for Hydro-Logic Services:

Alan Corner	Project Director, SUDS Specialist & Reviewer
Dr Paul Webster	Project Manager & Flood Risk Specialist
Rodrigo Magno	Hydraulic modeller
Phil Cannard	Hydrologist

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3 issue	Oct 2019	P Webster	A Corner	Issue version
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Limitation of liability and use

The work described in this report was undertaken for the party or parties stated; for the purpose or purposes stated; to the time and budget constraints stated. No liability is accepted for use by other parties or for other purposes, or unreasonably beyond the terms and parameters of its commission and its delivery to normal professional standards.

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1. Introduction

1.1 Planning Background

This Flood Risk Assessment (FRA) has been prepared by Hydro-Logic Services as a revised submission document to the FRA submitted under Applications A, B and C (refs. 18/0547/FUL, 18/0548/FUL and 18/0549/FUL) ('the Applications'), in respect of the former Stag Brewery Site in Mortlake ('the Site') within the London Borough of Richmond Upon Thames ('LBRuT'). The Applications are for the comprehensive redevelopment of the Site. This document has been prepared on behalf of Reselton Properties Limited ('the Applicant'). A summary of the Applications is set out below:

a) Application A – hybrid planning application for comprehensive mixed use redevelopment of the former Stag Brewery site consisting of:

   i. Land to the east of Ship Lane applied for in detail (referred to as 'Development Area 1' throughout); and

   ii. Land to the west of Ship Lane (excluding the school) applied for in outline (referred to as 'Development Area 2' throughout).

b) Application B – detailed planning application for the school (on land to the west of Ship Lane).

c) Application C – detailed planning application for highways and landscape works at Chalkers Corner.

This document replaces the original FRA.

The Applications were submitted in February 2018 to LBRuT. The Applications are related and were proposed to be linked via a Section 106 Agreement. In May 2019, a package of substitutions was submitted to LBRuT for consideration, which sought to address comments raised by consultees during determination. On 29 January 2020, the Applications were heard at LBRuT's Planning Committee with a recommendation for approval. This scheme is thereafter referred to as "**the Original Scheme**".

The Committee resolved to grant Applications A and B, and refuse Application C. The granting of Applications A and B was subject to the following:

a) Conditions and informatives as set out in the officer's report, published addendum and agreed verbally at the meeting;
b) Amendments to the Heads of Terms and completion of a Section 106 Legal Agreement which was delegated to the Assistant Director to conclude;
c) No adverse direction from the Greater London Authority ('GLA'); and
d) No call in by the Secretary of State for Housing, Communities and Local Government.

The Applications have been referred to the GLA and the Mayor has given a direction that he will take over the determination of the Applications and act as local planning authority in relation to all three applications.

The Applicant has engaged with the GLA in respect of the proposed amendments to the scheme, referred to throughout this document as the '**Revised Scheme**'. As a result of these discussions, a number of changes have been made to the scheme proposals which are summarised as follows:

a) Increase in residential unit provision from up to 813 units (this includes the up to 150 flexible assisted living and / or residential units) to up to 1,250 units;

b) Increase in affordable housing provision from up to 17% to up to 30%;

c) Increase in height for some buildings, of up to three storeys compared to the Original Scheme;

d) Change to the layout of Buildings 18 and 19, conversion of Block 20 from a terrace row of housing to two four storey buildings;

e) Reduction in the size of the western basement, resulting in an overall reduction in car parking spaces of 186 spaces, and introduction of an additional basement storey beneath Building 1 (the cinema);

f) Other amendments to the masterplan including amendments to internal layouts, re-location and change to the quantum and mix of uses across the Site, including the removal of the nursing home and assisted living in Development Area 2;

g) Landscaping amendments, including canopy removal of four trees on the north west corner of the Site; and

h) Change to works proposed at Chalkers Corner (originally proposed under Application C) – at present no works are proposed to the land at Chertsey Court or the north side of Lower Richmond Road. Works are proposed to the adopted highway land at Chalkers Corner.

The submission documents have tested an affordable housing provision of 30%. However, it should be noted that the final affordable housing level is subject to further viability testing and discussions with the GLA.

Minor amendments have also been made to the road and pedestrian layouts for the school (Application B). No other amendments are proposed to Application B.

A more detailed summary is included within the Planning Statement Addendum and Design and Access Statement Addendum submitted with the Revised Scheme documents.

These changes are being brought forward as substitutions to Applications A and B (refs. 18/0547/FUL and 18/0548/FUL), which are related applications (to be linked via a Section 106 Agreement). The works as proposed under Application C (ref. 18/0549/FUL) (Chalkers Corner) are no longer being progressed in their present form. Associated highways works may be carried out on adopted highways land. If they are on adopted highway they will not require separate planning permission. It should be noted that as the present highway works are proposed under Section 278, the detail shown is illustrative and final details will be secured with TfL and LBRuT via the Section 278 process. If it is agreed that all necessary highway works are within the adopted highway then Application C may be withdrawn.

1.2 Purpose of this Report

This Report presents a Flood Risk Assessment (FRA) for the proposed redevelopment of the former Stag Brewery in Mortlake. The FRA includes the development of a Drainage Strategy. The development of the Drainage Strategy has been undertaken by Waterman Infrastructure & Environment Limited ('Waterman IE'), in conjunction with Hydro-Logic Services and is summarised within this FRA.

The National Planning Policy Framework (NPPF) was published on 2012, revised in July 2018 and February 2019 and sets out the Government's planning policies for England and how these are expected to be applied. Flooding is addressed, principally in paragraphs 155 to 165

of the NPPF. These seek to avoid inappropriate development in areas at risk of flooding by directing development away from areas at highest risk, but where development is necessary, making it safe without increasing flood risk elsewhere.

A site-specific flood risk assessment is required for proposals of 1 hectare or greater in Flood Zone 1; all proposals for new development (including minor development and change of use) in Flood Zones 2 and 3, or in an area within Flood Zone 1 which has critical drainage problems (as notified to the local planning authority by the Environment Agency); and where proposed development or a change of use to a more vulnerable class may be subject to other sources of flooding.

A site-specific flood risk assessment must demonstrate the following:

- that the development will be safe for its lifetime taking account of the vulnerability of its users;
- it should not increase flood risk elsewhere;
- it should if possible, reduce flood risk overall.

1.3 Sources of Information and Consultation

A Scoping (Level 1) Flood Risk Assessment was prepared for the site in July 2016 (Appendix B). This was submitted to the Environment Agency and London Borough of Richmond upon Thames (LBRuT). Useful responses were obtained from both organisations, as shown in Appendix C . In particular, these have helped to Scope the requirements for this full FRA.

This Report has also been informed by:

- Product 4 flood data provided by the Environment Agency to Waterman IE in February 2016 (Ref KSL 2030);
- Product 7 flood data (The Lower Thames Model) provided to Hydro-Logic Services in January 2017 (Ref KSL 24434);
- Product 4 & 8 flood data, provided by the Environment Agency to Hydro-Logic in July 2017 (Ref KSL 52746);
- Development proposals provided by Squire and Partners throughout the project;
- Landscaping and River wall proposals provided by Gillespies LLP;
- Site visit by Dr Paul Webster on 16th June 2016.

1.4 Structure of Report

The Report has been structured in order to deal with key flood related issues of the NPPF Practice Guide, for which a checklist has been reproduced as Appendix A of this Report. The principal sections of the Report are as follows:

- Section 2 refers to spatial planning considerations by reference to the proposed land use and flood zoning;
- Section 3 presents an assessment of the existing flood risk at the application sites;
- Section 4 presents an assessment of flood risks associated with the proposed development along with any mitigation that may be required;
- Section 5 presents a summary of the main findings.

Additional Appendices are provided that deal with the following:

- Appendix B is the Scoping Level FRA submitted by Hydro-Logic Services to the Environment Agency and LBRuT;
- Appendix C provides the responses of the Environment Agency and LBRuT to the Scoping Level FRA;
- Appendix D is a Breach Analysis;
- Appendix E shows extracts from sewer maps provided by Thames Water;
- Appendix F provides the Environment Agency Climate Change Allowances (at February 2016);
- Appendix G is the Flood Emergency Plan
- Appendix H provides drawings of the proposed passive defence for Ship Lane;
- Appendix I .is the Environment Agency response to tidal defence proposals.

2. Spatial Planning Considerations

2.1 Location Plan and Site Plan

The "Site" is the former location of the Stag Brewery, located at Mortlake in the London Borough of Richmond upon Thames (LBRuT) plus some surrounding areas, as described in this Section. It is located south west of a large meander on the River Thames which flows to the east. Its general location is shown in Figure 2-1 and an aerial photo of the site is shown in Figure 2-2.

The **Site** comprises:

- the former Stag Brewery, an approximately 9.25 hectare (ha) parcel of land, occupied by a mix of large scale industrial brewery structures and buildings, hardstanding and a playing field in the south west known as Watney's Sports Ground, and incorporating a section of the River Thames towpath within the north of the Site;
- Ship Lane, a public highway bisecting the abovementioned 9.25 ha parcel of land;
- Bull's Alley, a public highway within the east of the abovementioned 9.25 ha parcel of land;
- Williams Lane, a highway within the west of the abovementioned 9.25 ha parcel of land;
- a section of Lower Richmond Road within the south of the abovementioned 9.25 ha parcel of land;
- a section of Mortlake High Street within the south of the abovementioned 9.25 ha parcel of land; and
- a section of Sheen Lane within the south of the abovementioned 9.25 ha parcel of land.

Table 2-1 Grid reference details for the site (www.streetmap.co.uk)

Reference	Value
OS X (Eastings)	520341
OS Y (Northings)	176027
Nearest Post Code	SW14 7ET
Lat (WGS84)	N51:28:14 (51.470421)
Long (WGS84)	W0:16:08 (-0.268803)
Nat Grid	TQ203760 / TQ2034176027

Figure 2-1 General location of the proposed Development

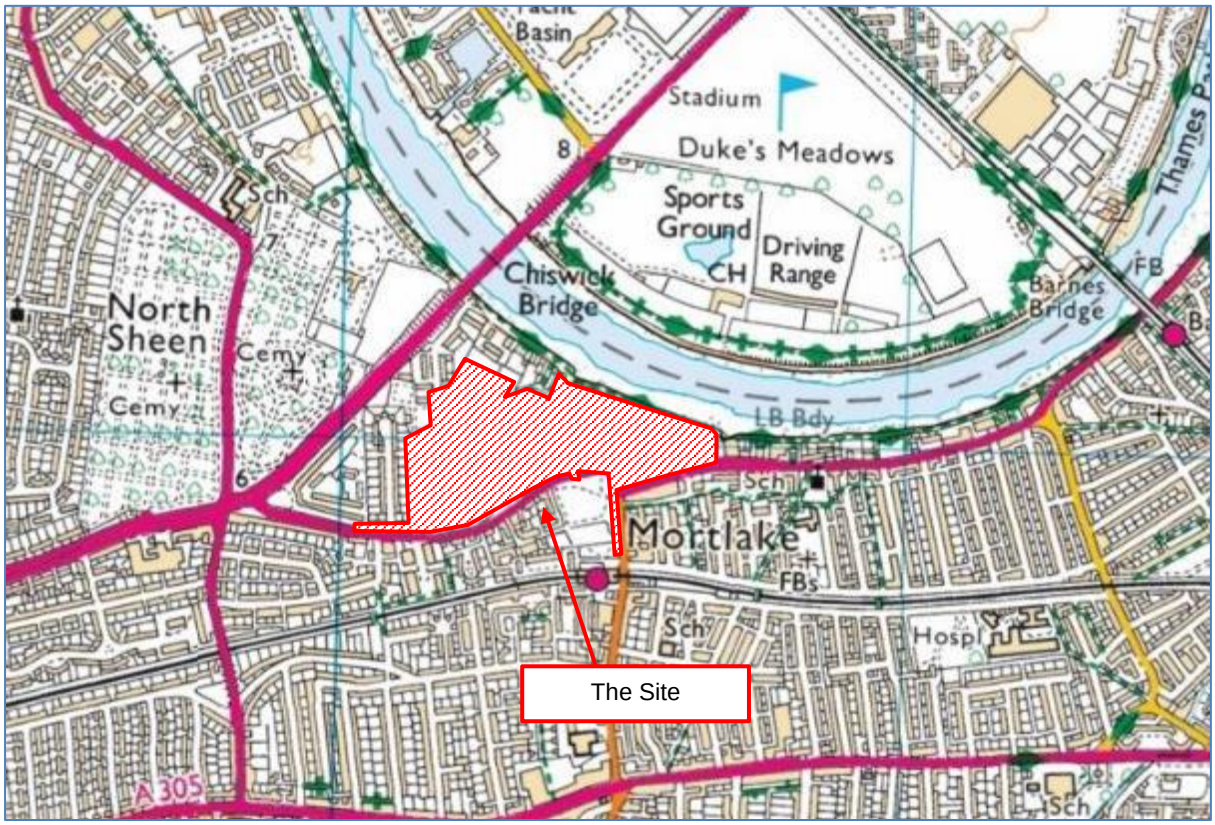

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Figure 2-2 Aerial photo of the Site

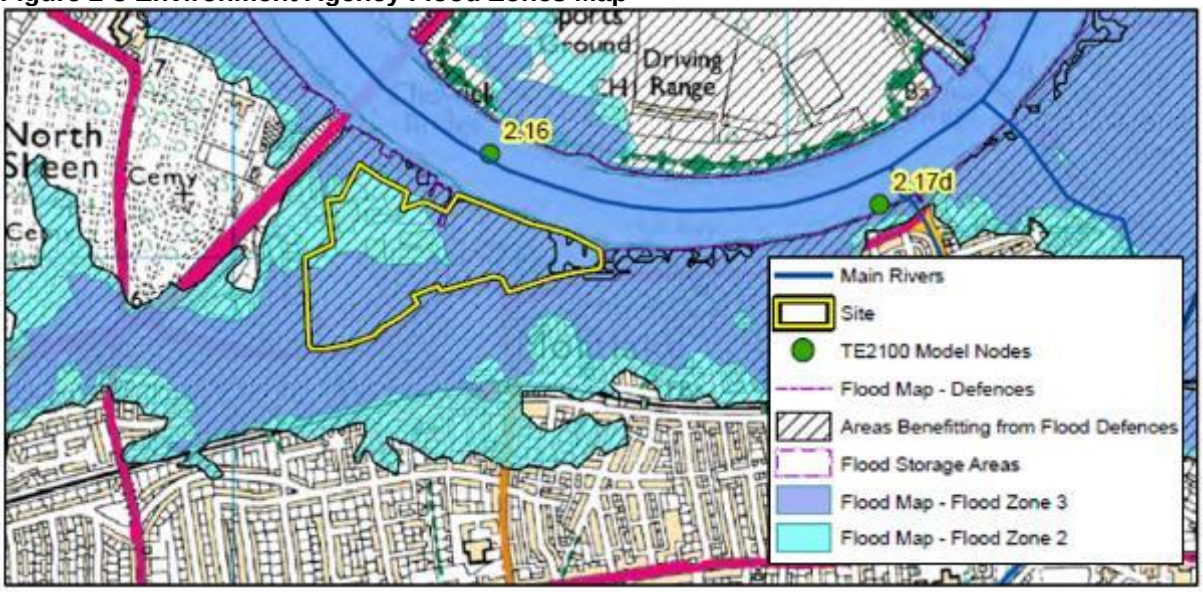
2.2 Environment Agency Flood Zone

The definitions of flood zones adopted by PPS25/NPPF are as follows:

- ***Zone 1: 'Low Probability'*** *– This zone comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%).*
- ***Zone 2: 'Medium Probability'*** *– This zone comprises land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (1% - 0.1%) or between a 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5%-0.1%) in any year.*
- ***Zone 3a: 'High Probability'*** *– This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year.*
- ***Zone 3b: 'The Functional Floodplain'*** *– This zone comprises land where water has to flow or be stored in times of flood. SFRAs should identify this Flood Zone (land which would flood with an annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in an extreme (0.1%) flood, or at another probability to be agreed between the LPA and the Environment* Agency, including water conveyance routes).

The Environment Agency have provided maps of the flood zones (Figure 2-3). This shows that the east and south of the Site is in flood zone 3 within the 0.5% Annual Exceedance Probability (AEP) flood event. The north east of the Site is located in flood zone 2 in the 0.1% AEP flood event.

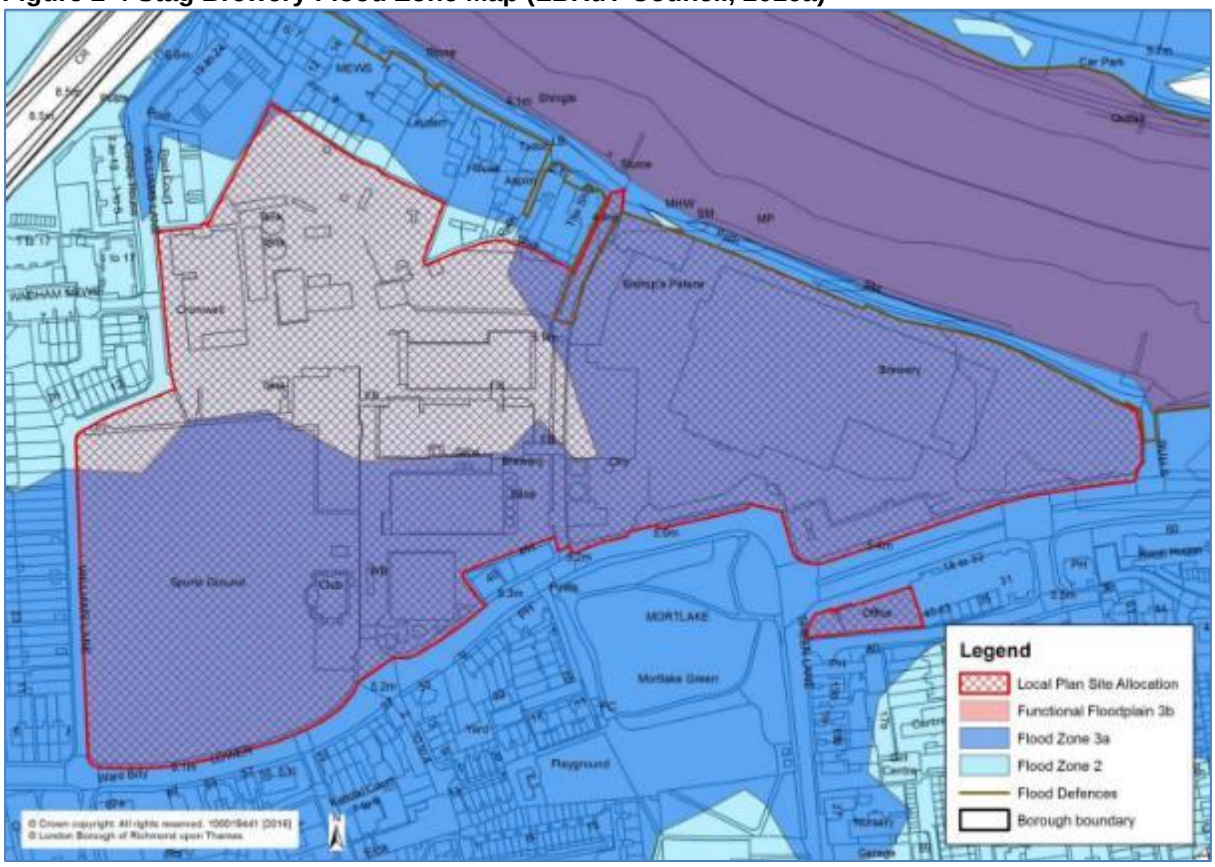
Figure 2-3 Environment Agency Flood Zones Map



Copyright Environment Agency. Note that identical maps were provided in Product 4 data sets in 2016 and 2017. This map shows a site boundary that has now been superseded.

It is also important for planning purposes, to establish if any of the site lies in the functional flood plain (termed flood zone 3b). The Flood Risk Sequential Test (LBRuT Council, 2016a) focuses on the Stag Brewery site and confirms that the site is not located in flood zone 3b (Figure 2-4).

Figure 2-4 Stag Brewery Flood Zone Map (LBRuT Council, 2016a)



This map shows a site boundary that has now been superseded.

2.3 The Strategic Flood Risk Assessment and Sequential Test

The Strategic Flood Risk Assessment (SFRA) has been prepared by the London Borough of Richmond upon Thames (LBRuT) Council (2016c). This has provided a useful source of information to guide this FRA. Mortlake is specifically mentioned as having a tidal and fluvial flood risk from the nearby River Thames. Other flood risks are also covered in this SFRA (see section 3.2).

The NPPF includes a table to highlight whether particular types of development are appropriate in each flood zone. This is reproduced as Table 2-2. The proposed development would be classed as a more vulnerable development in accordance with the classification in Table 2-2, since the **most vulnerable use classification class** is used across the development site. More vulnerable developments are considered to be appropriate in flood zone 2 but are subject to the exception test in flood zone 3a (Table 2-3).

Table 2-2 Flood risk vulnerability classification

More Vulnerable (MV)
Hospitals.
Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels.
Buildings used for: dwelling houses; student halls of residence; drinking establishments; nightclubs; and hotels.
Non–residential uses for health services, nurseries and educational establishments.
Landfill and sites used for waste management facilities for hazardous waste.
Sites used for holiday or short-let caravans and camping, **subject to a specific warning and evacuation plan**.
Less Vulnerable (LV)
Police, ambulance and fire stations which are not required to be operational during flooding
Buildings used for: shops; financial, professional and other services; restaurants and cafes; hot food takeaways; offices; general industry; storage and distribution; non–residential institutions not included in 'more vulnerable'; and assembly and leisure.
Land and buildings used for agriculture and forestry.
Waste treatment (except landfill and hazardous waste facilities).
Minerals working and processing (except for sand and gravel working).
Water treatment works which do not need to remain operational during times of flood

Table 2 from NPPF Technical Guide (Paragraph 066)
Text in bold italics denotes all land uses proposed for the Site

Table 2-3 Flood risk vulnerability and flood zone compatibility

Flood Zone	Definition	Essential Infrastructure	Water compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
1	T>1,000	✔	✔	✔	✔	✔
2	100<T_{fluv}<1,000 200<T_{tidal}<1,000	✔	✔	Exc	✔	✔
3a	T_{fluv}<100 T_{tidal}<200	Exc.	✔	✕	Exc	✔
3b (functional floodplain)	T_{fluv}<20	Exc	✔	✕	✕	✕

Based on Table 3 from the NPPF Technical Guide (Paragraph 067)

Notes:

✔	development is appropriate	T	return period (fluv = fluvial)
✕	development should not be permitted	Exc	exception test should be applied

The overall aim of decision-makers should be to steer new development away from Flood Zone 3, ideally to Flood Zone 1. Where there are no reasonably available sites in Flood Zone 1, then sites would be considered in Flood Zone 2 and then 3. The Sequential Test requires an assessment of available and equivalent sites in the LBRuT area to ascertain if others are available that are at lower risk of flooding. The Stag Brewery site has been commented on in the LBRuT council's Flood Risk Sequential Test (2016a) which states that:

"This is a site for major redevelopment and regeneration as the brewery has closed, and as such, it is not appropriate / possible to accommodate the proposed uses on an alternative site in the borough at lower probability of flooding. The sequential approach should be applied on the site and a site-specific FRA will be required. Flood Hazard and TE2100 levels will need to be taken into account."

The Sequential Test is therefore deemed to have been satisfied, and is confirmed in the pre-application advice from LBRuT subject to review by the Environment Agency (Appendix C.2).

The Exception Test now has two parts and the extent to which it satisfies these elements is described below:

(a) That the development supports wider sustainability benefit to the community that outweigh flood risk, informed by the SFRA.

This development meets this criterion, as confirmed from the pre-application advice from LBRuT which states:

"…the Council can confirm that development of this site in line with the draft Local Plan proposal site (SA23), as supported by the Flood Risk Sequential Test, will provide wider sustainability benefits because it is now a derelict site that is in need of regeneration, and the proposal will create a new village heart for Mortlake with a mix of uses, including enlivening the riverside frontage." (Appendix C.2)

(b) that the site can be safely developed without increasing flood risk elsewhere

This FRA provides the confirmation in Section 4 that there is no increase in flood risk elsewhere and can be made safe for residents.

Evidence is thus provided, or referred to in this FRA, to demonstrate that both the Sequential and Exception Tests have been satisfied.

2.4 Other relevant policies

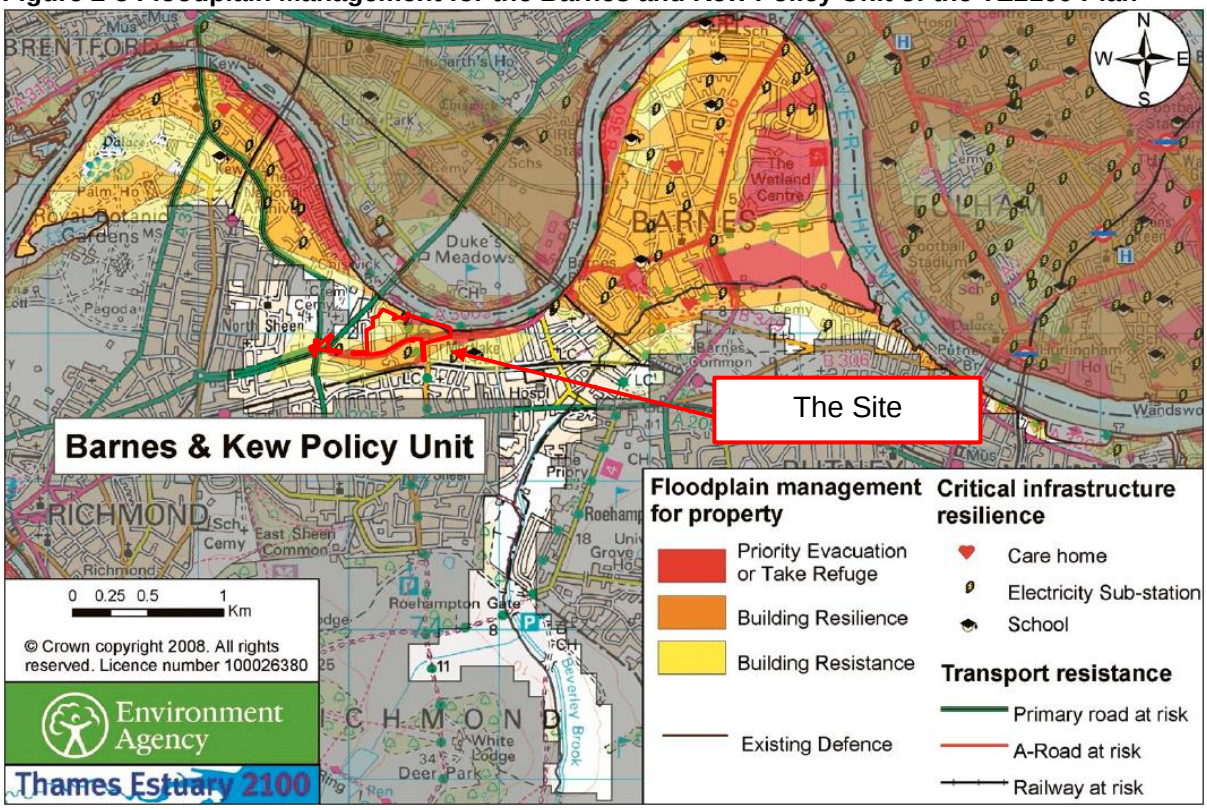
The **LBRuT Local Development Framework Core Strategy** (LBRuT, 2009) sets out the key planning policies of the borough council. Policy CP3 focusses on climate change and states that this must be accounted for within the development. This includes accounting for climate change in the drainage strategy and the flood risk posed by the River Thames.

The **Local Development Management Plan** (LBRuT, 2011) expands on the policies from the LBRuT Local Development Framework Core Strategy and includes a focus on sustainability. Policy DM SD 6 sets out the flood risk requirements which includes mitigation measures and states that a Flood Warning and Evacuation Plan would be required. Policy DM SD 7 focusses on Sustainable Drainage and states that wherever possible, Sustainable Drainage Systems (SuDS) must be used and surface water discharge from the site should be reduced to greenfield rates. Policy DM SD 8 considers flood defences and states that flood defences must be maintained and that any development within 16 m of the tidal River Thames will require consent from the Environment Agency.

The **LBRuT Local Plan** (LBRuT, 2018) supersedes the policies in the two preceding documents. The new policies for flood risk and sustainable drainage are covered in policy LP 21.

The tidal areas of the Thames Estuary are covered by the **Thames Estuary 2100** (TE2100) plan. This aims to manage and reduce the tidal flood risk from the estuary over the next 100 years. The site is located within action zone 1 under the Barnes and Kew policy unit. Within this area, the policy is to keep take action to reduce flood risk beyond that predicted by climate change. For the proposed development, it is indicated the floodplain management actions to be taken should be a combination of priority evacuation and building resilience and resistance. This is illustrated for the relevant Flood Plain Management Unit (Barnes and Kew) in Figure 2-5.

Figure 2-5 Floodplain Management for the Barnes and Kew Policy Unit of the TE2100 Plan



Environment Agency (2012)

The **London Plan** was revised in 2016, consolidating a range of documents with the 2011 London Plan. A revised draft Plan was also prepared in 2019. Through Policy SI 12 (Flood Risk Management), the Mayor seeks to *"work with all relevant agencies including the Environment Agency to address current and future flood issues and minimise risks in a sustainable and cost-effective way."*. Through Paragraph 9.12.3, the Plan endorses the Thames Estuary 2100 plan. However, of greatest relevance to this FRA is Policy SI 13 (Sustainable Drainage). This states that:

> *[B] Development proposals should aim to achieve greenfield run-off rates and ensure that surface water run-off is managed as close to its source as possible. There should also be a preference for green over grey features, in line with the following drainage hierarchy:*
>
> 1. *rainwater use as a resource (for example rainwater harvesting, blue roofs for irrigation)*
> 2. *rainwater infiltration to ground at or close to source*
> 3. *rainwater attenuation in green infrastructure features for gradual release (for example green roofs, rain gardens)*
> 4. *rainwater discharge direct to a watercourse (unless not appropriate)*
> 5. *controlled rainwater discharge to a surface water sewer or drain*
> 6. *controlled rainwater discharge to a combined sewer.*
>
> *[C] Development proposals for impermeable surfacing should normally be resisted unless they can be shown to be unavoidable, including on small surfaces such as front gardens and driveways.*
>
> *[D] Furthermore, drainage should be designed and implemented in ways that promote multiple benefits including increased water use efficiency, improved water quality, and enhanced biodiversity, urban greening, amenity and recreation.*

3. Flood Hazard for Existing Site

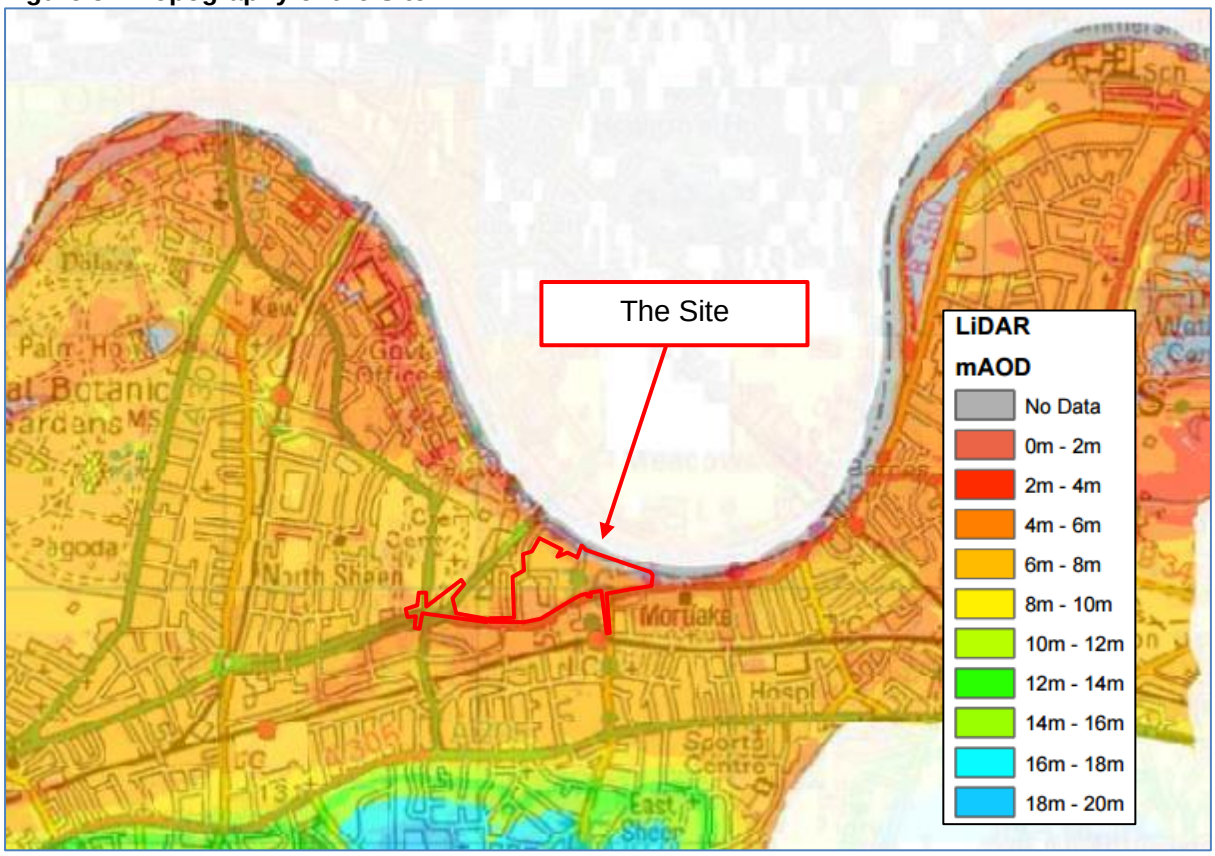
This Section reviews the characteristics of the catchment area that affect the Site. This provides the context for reviewing the sources of flooding to the site and the flood risk.

3.1 Site and Catchment Characteristics

3.1.1 Topography

The topography of the Site is relatively flat and is located on low lying land. The LiDAR map (Figure 3-1) indicates that it is lowest to the east of the Site (4 to 6 mAOD) and highest in the north west of the Site (8 to 10 mAOD).

Figure 3-1 Topography of the Site



3.1.2 Geology and soils

According to the Preliminary Environmental Risk Assessment (PERA) undertaken by Waterman IE, the geology throughout the Site is composed of Hardstanding, underlain by Made Ground, Alluvium, Kempton Park Gravel Formation, London Clay Formation, Lambeth Group, Thanet Formation and Chalk Group (Figure 3-2 shows Kempton Park Gravel as the main superficial deposit). It is anticipated shallow groundwater in the Alluvium and Kempton Park Gravel Formation is in hydraulic continuity with the River Thames directly adjacent to the Site. This presents a risk to the Site of water finding a pathway through the gravel when the River Thames is at a high water level, which could cause groundwater flooding. The Site is located on soils described as Soilscapes 6 which are "*Freely draining, slightly acid loamy soils*" (Figure 3-3). While this indicates that infiltration drainage techniques could be used, the Site's

proximity to the River Thames indicates that infiltration could be inappropriate due to a high groundwater table.

Figure 3-2 The Geology Attributes at the Site

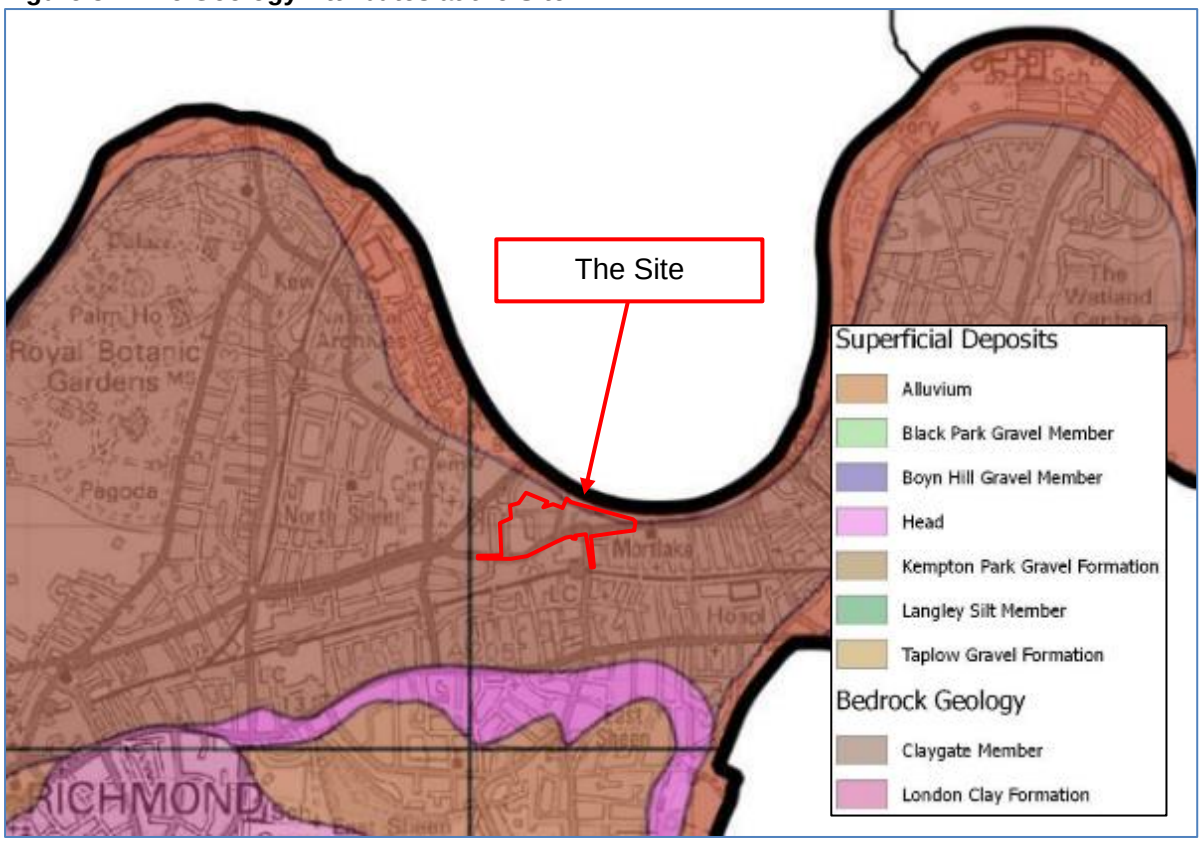
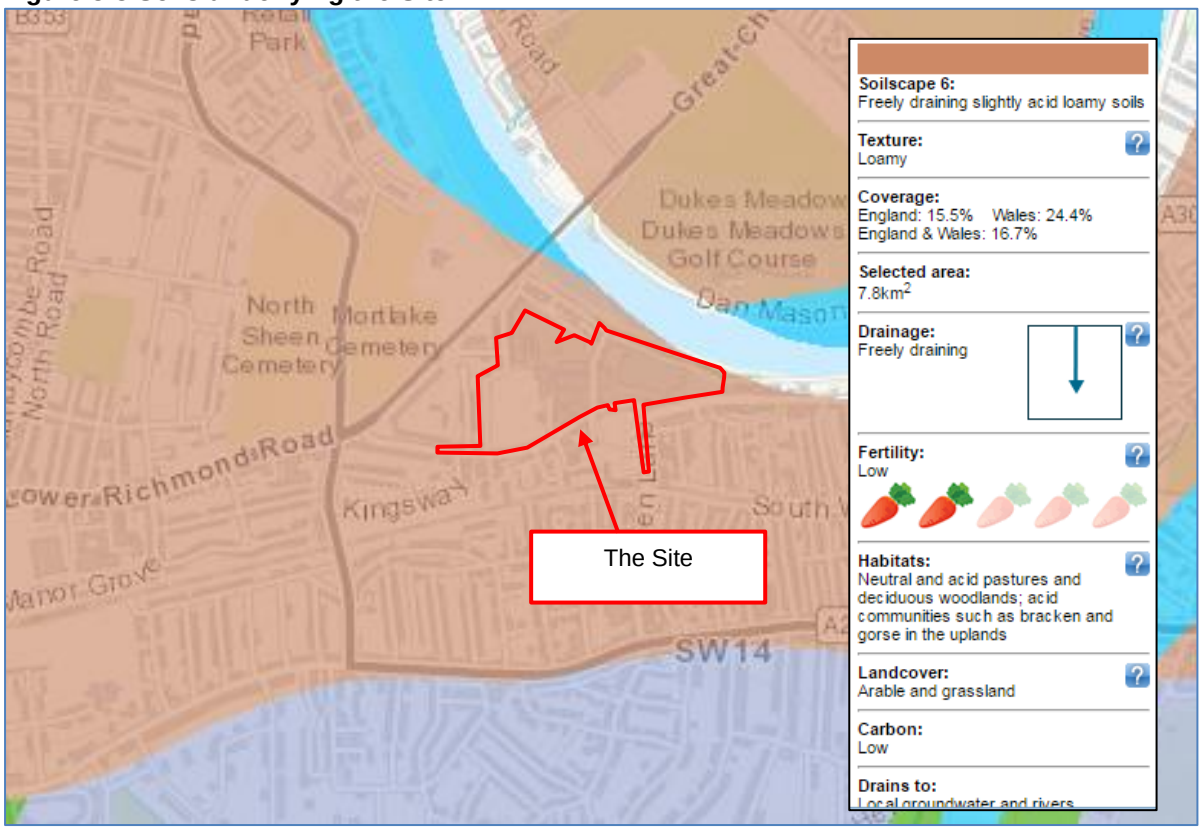


Figure 3-3 Soils underlying the Site



3.2 Sources of Flood Risk

The principal sources of flood risk are shown in Table 3-1. More detailed consideration is given in Section 3.3

Table 3-1 Possible sources of flood risk

Key sources of flooding	Possibility at Site
Fluvial (Rivers)	*Very low risk as fluvial levels would not overtop defences*
Tidal	*Moderate risk since it is located in the River Thames flood zones 3a and 2*
Groundwater	*Possible risk from its proximity to the River Thames*
Sewers	*Very low risk; No historical records*
Surface water	*Very low risk*
Infrastructure failure	*Very low risk associated with reservoirs located to west of London, namely Queen Elizabeth II and Queen Mary Reservoirs.*

Based on NPPF Practice Guide

3.3 Flood Mechanisms

3.3.1 Tidal

The dominant flood risk to the Site comes from the tides on the River Thames. This can occur from high tides combined with storm surges.

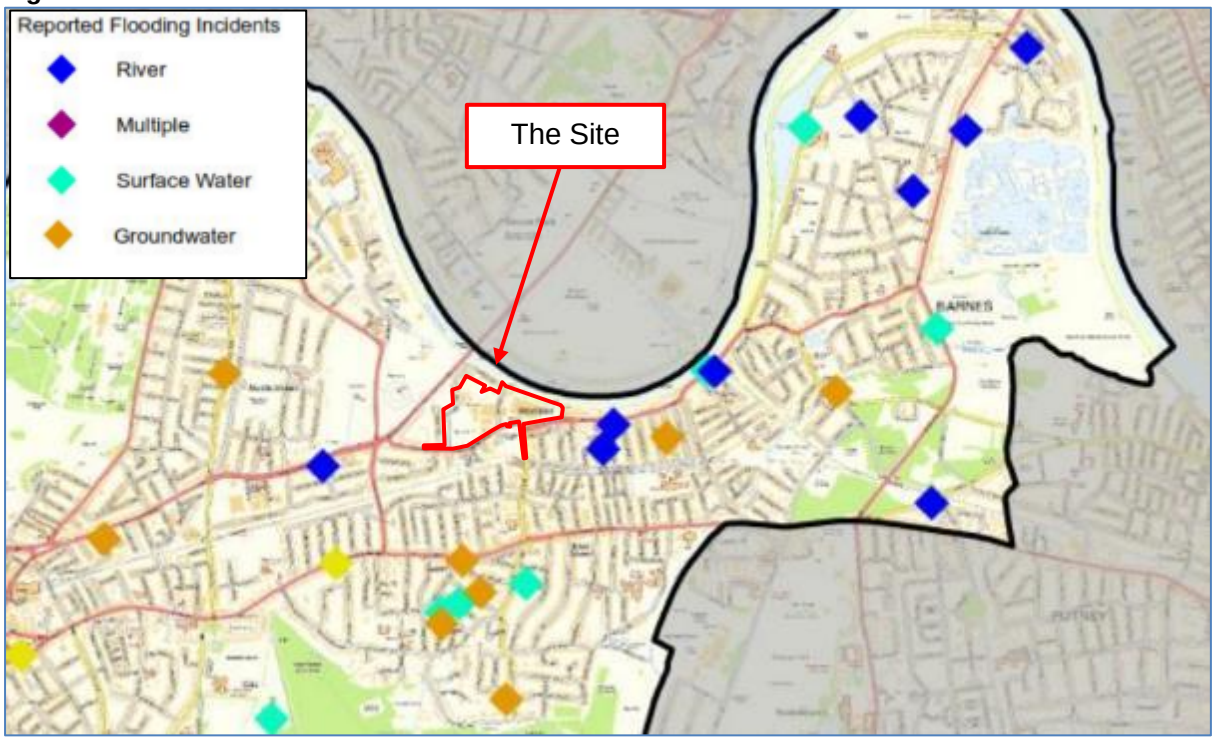
The Site is protected by formal Thames Tidal Flood defences, including the Thames Barrier. This controls the tidal water levels and, in combination with other defences, should limit flooding up to the 0.1% Annual Exceedance probability (AEP) flood event. Apart from the Thames Barrier, these defences are privately owned and it is the responsibility of the riparian owner to manage and maintain them. The boundary wall on the site of the Stag Brewery forms part of the flood defence at this location. In the cases that these defences were breached, different parts of the site would exhibit different hazards, ranging from low to extreme (see section 3.5).

The nearest tidal level station to the site is at Kew, as documented by the Port of London Authority (2016). This shows the following level information:

- Chart datum is 1.07 m below Ordnance Datum
- HAT (Highest astronomical tide) = 5.9 mACD = 4.8 mAOD
- MHWS (Mean High Water Springs) = 5.2 mACD = 4.1 mAOD
- MHWN (Mean High Water Neaps) = 4.2 mACD = 3.1 mAOD

While there are no reported historic flood incidents at the site (LBRuT, 2016a), there have been several flood incidents from the river near to the site (Figure 3-4).

Figure 3-4 Historic Flood Incidents



3.3.2 Groundwater

The BGS susceptibility to groundwater flooding map (Figure 3-5) indicates that the eastern and southern areas of the Site are susceptible to groundwater flooding at the surface. The remaining areas of the Site are susceptible to groundwater flooding below the ground. While no groundwater flood incidents have been recorded at the Site, there have been several groundwater flood incidents near the Site (Figure 3-4).

The mechanism for groundwater flooding could occur from two sources and the associated pathways. The first source is from high water levels in the River Thames. Since the Site is located on Kempton Gravel Formation, this could allow water to find a pathway through the gravel into the Site.

A second mechanism is from the minor aquifer over which the Site is located (Figure 3-6). This indicates a risk from groundwater flooding that could be caused by high seasonal rainfall which increases the groundwater levels in the aquifer. Since some areas of the Site have a low elevation (Figure 3-1), this could increase its susceptibility to groundwater flooding from a high water table.

AECOM was commissioned in 2015 to undertake an Environmental Site Assessment Report in preparation for the proposed planning application (AECOM 2015a and 2015b). This included a collation of available groundwater monitoring information and a new set of observations in September 2015.

The main findings of their investigations were:

- Observed water levels vary over the site from around 2 mAOD in the east of the Site to 1.3 mAOD in the west. The hydraulic gradient is thus downwards to the west in the western part of the Site. However, in the centre, the gradient is downwards to the south-west (Figure 3-7).

Figure 3-5 BGS Groundwater Map (LBRuT, 2016c)

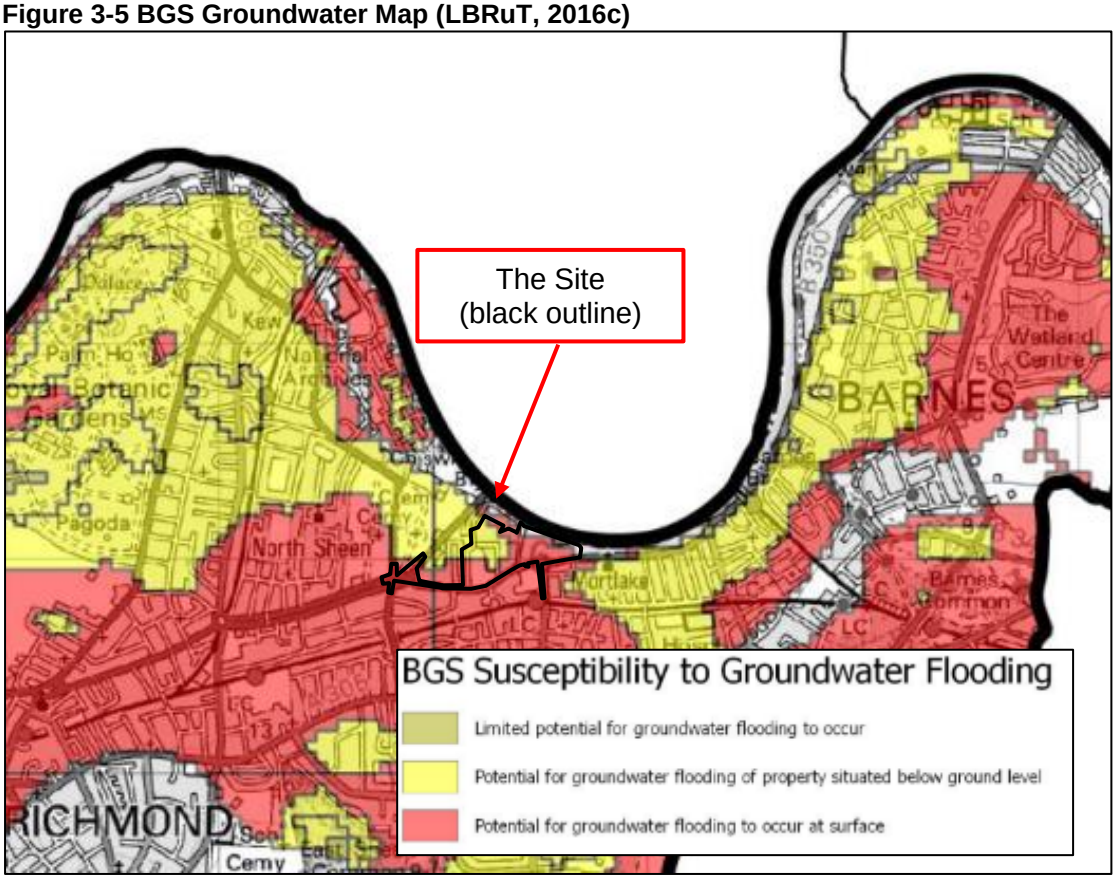
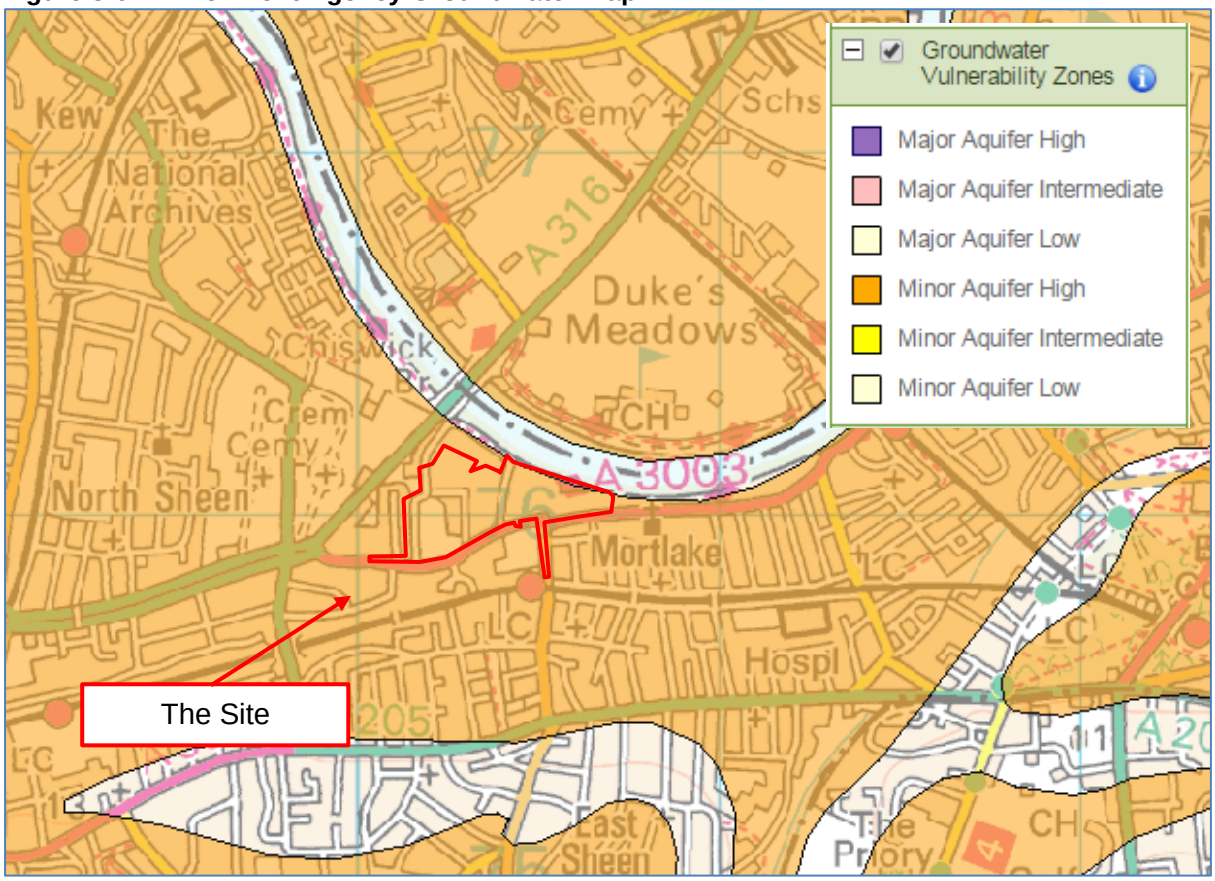


Figure 3-6 Environment Agency Groundwater Map



- The hydraulic gradient therefore contrasts with the topographic gradient which is downwards to the east across the Site.

- A review of water levels over time confirms that they vary systematically across the Site, with a typical range of about 0.5 m between the highest and lowest values (Figure 3-8).

- The influence of the tidal variation in the Thames was investigated through deployment of monitors at three of the boreholes. The closest borehole to the Thames that was monitored was BH201a, located approximately 20 m from the southern bank of the Thames. The record from BH201A shows a very subdued response to tidal variation centred around 2 mAOD over the time of observations (Figure 3-9), as expected because the borehole is located in the inter-tidal zone.

As part of their Environmental Risk Assessment in 2016 for the east part of the Site (east of Ship Lane), Waterman IE also made measurements of groundwater levels at a new set of boreholes. The locations of the additional boreholes are shown in Figure A.4 and the observations in Appendix D of Waterman IE (2016b). The observed water levels have been annotated in red on Figure 3-7. Based on the findings by AECOM and the observations by Waterman IE (2016b), the following hydrogeological interpretation can be made about the Site:

- Since the hydraulic gradient slopes downwards away from the river, the river appears to be acting as a "source" of groundwater flow when considered together with flows from existing surface water drainage arrangement (see Section 3.4) under wet weather conditions.

- Although the river levels are subject to tidal variation, the effects diminish with distance from the river, such that at 20 m for Borehole 201A, they are very subdued. The head boundary condition imposed by the Thames will therefore approximate to the average recorded water levels. This is logically around 2 mAOD (based on Figure 3-9) and which is consistent with the closest available water level recorders at Richmond (Figure 3-10) and Chelsea (Figure 3-11), for which average water levels are around 2.4 mAOD and 0.7 mAOD respectively.

- AECOM sought to investigate the hydrogeology of the east of the Site by drilling boreholes BH203 and BH203A. The borehole logs show that these had limited success since they encountered concrete (Figure 3-12 and Figure 3-13). The investigations by Waterman IE also sought to better understand the east of the Site through the drilling of additional boreholes, though these also encountered obstructions. These undermine any strong inferences about the hydrogeology of this part of the site.

- The general observations by Waterman IE are broadly consistent with the interpretation by AECOM. However, the picture is varied with some dry wells and other wells showing water levels within 2 to 3 m of the ground level. It seems likely that this variation reflects the complexity of the east of the Site and the numerous anthropogenic and building work interventions over a long period. It is possible (rather than probable) that the observed water levels of around 3 mAOD which were obtained in February 2016 and similar values obtained by Waterman IE in October 2016 represent a perched water table associated with the underlying Palaeogene minor aquifer. However, the relationship between the Palaeogene minor aquifer and the Kempton gravel formation does not support the assumption of a perched water table. The

presence of building work artefacts in the eastern part of the Site may be responsible for the impermeable concrete encountered at various depths through the drilling of BH203 and BH203A as recorded in their borehole logs.

It is therefore concluded that the risk to the Site and the surrounding area from groundwater is low over the majority of the Site. However, in the extreme east, there is some uncertainty over the relative influence of the mechanisms controlling groundwater flow through the Site: flows through the high permeability Kempton gravels and / or groundwater flows in the underlying minor aquifer. The possible impacts of the proposed Development on groundwater risk are reviewed in Section 4.

Figure 3-7 Groundwater Contour Map (AECOM, 2015b) supplemented by Waterman IE's observations on 27 October 2016 in red

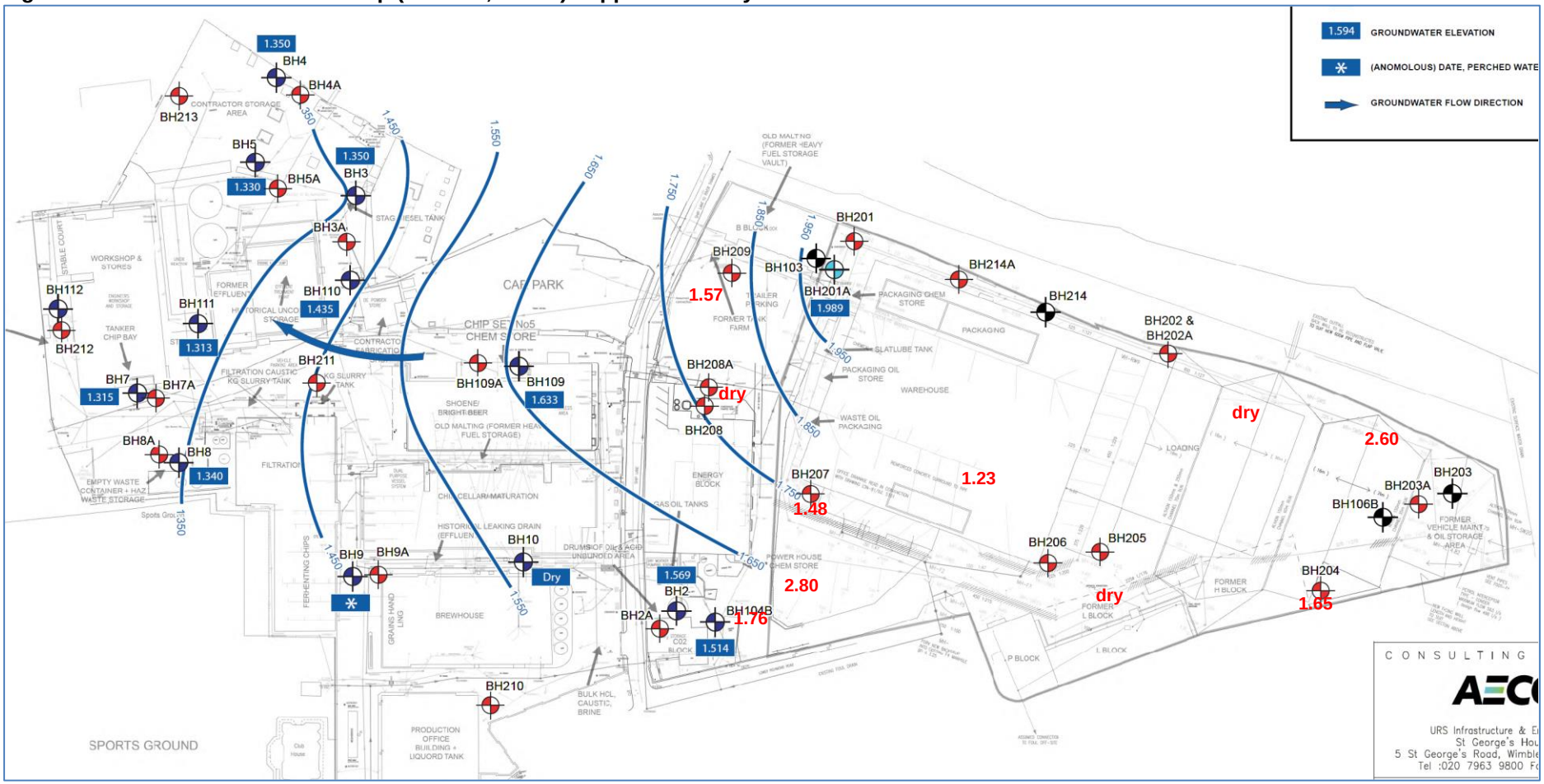


Figure 3-8 Selected Groundwater Levels over time (AECOM, 2015b)

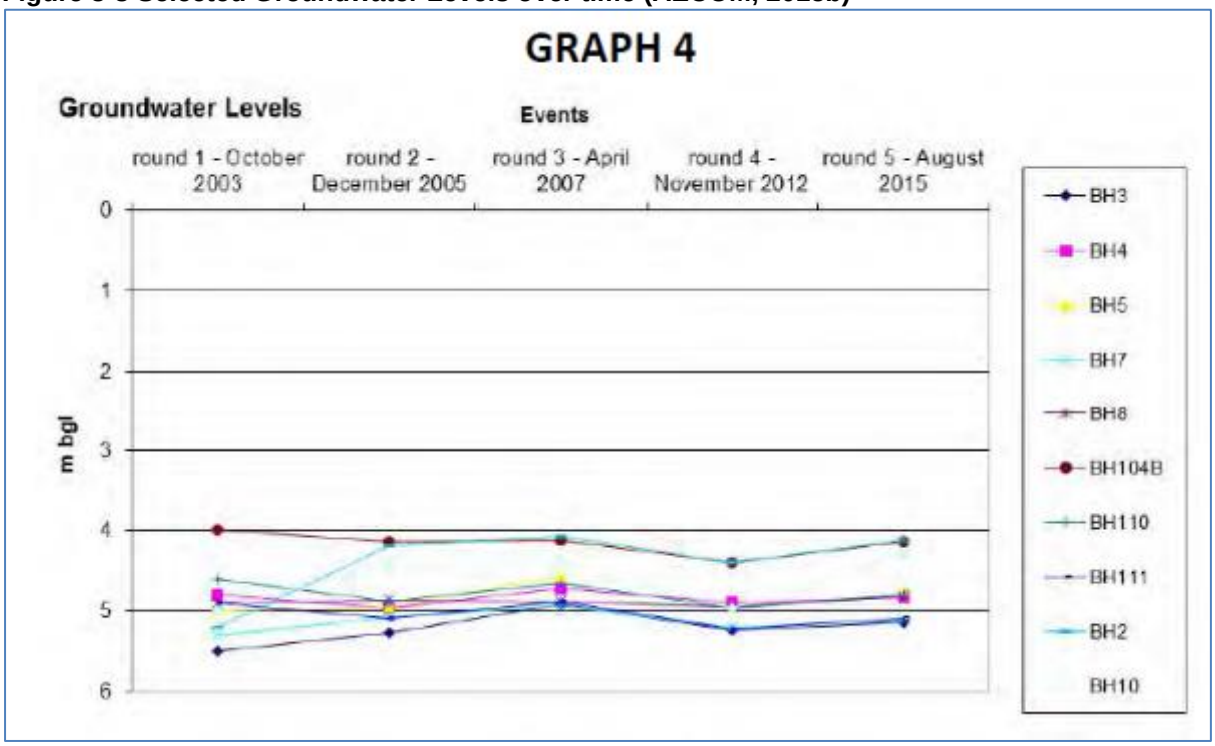


Figure 3-9 Level hydrograph for Borehole BH201A (AECOM, 2015b)

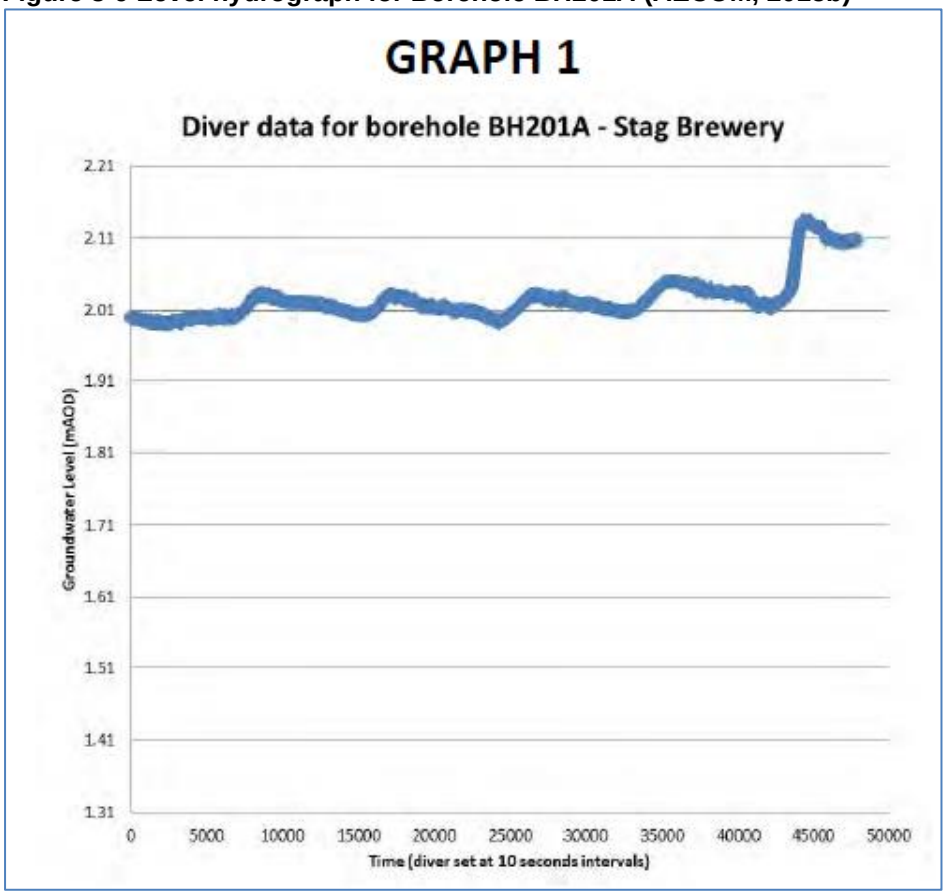


Figure 3-10 Level hydrograph for Richmond (Environment Agency)

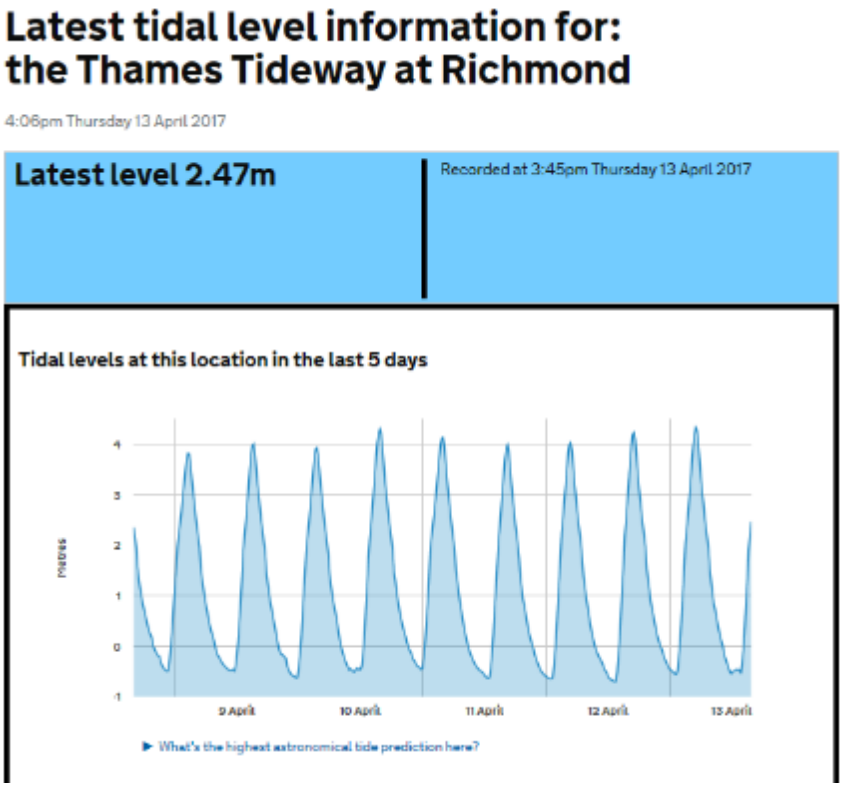


Figure 3-11 Level hydrograph for Chelsea (Environment Agency)

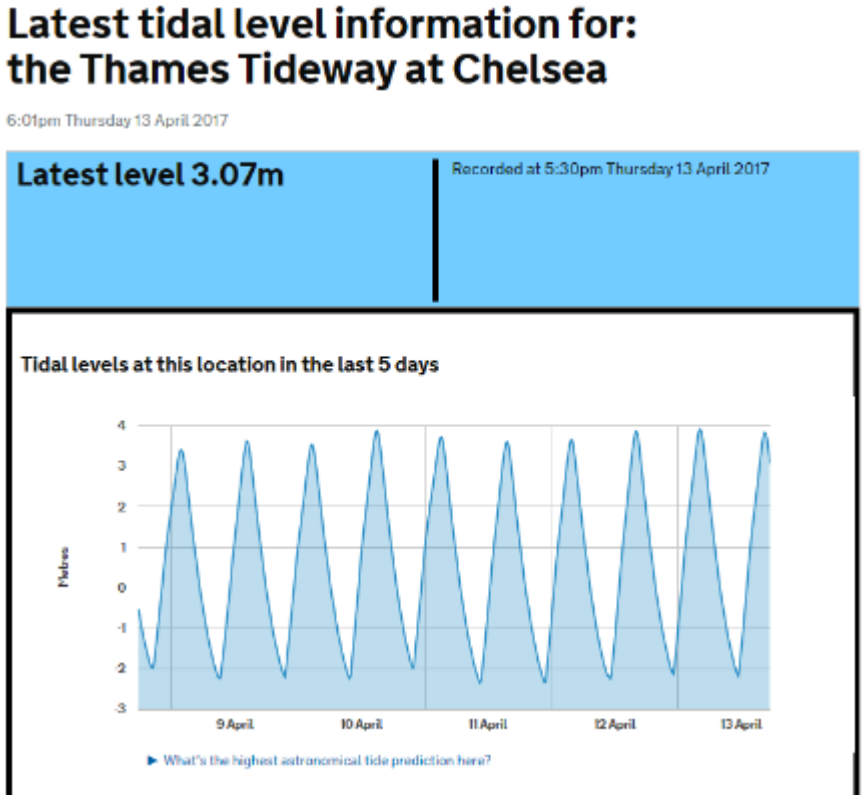
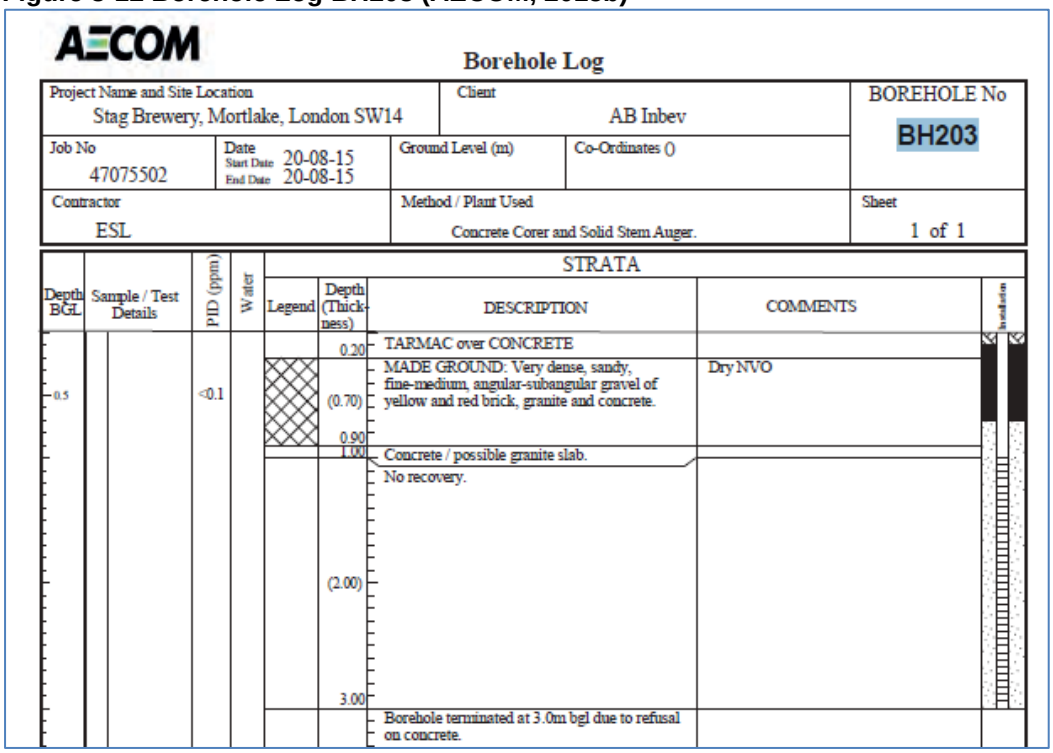


Figure 3-12 Borehole Log BH203 (AECOM, 2015b)



AECOM

Borehole Log

Project Name and Site Location	Client	BOREHOLE No
Stag Brewery, Mortlake, London SW14	AB Inbev	BH203

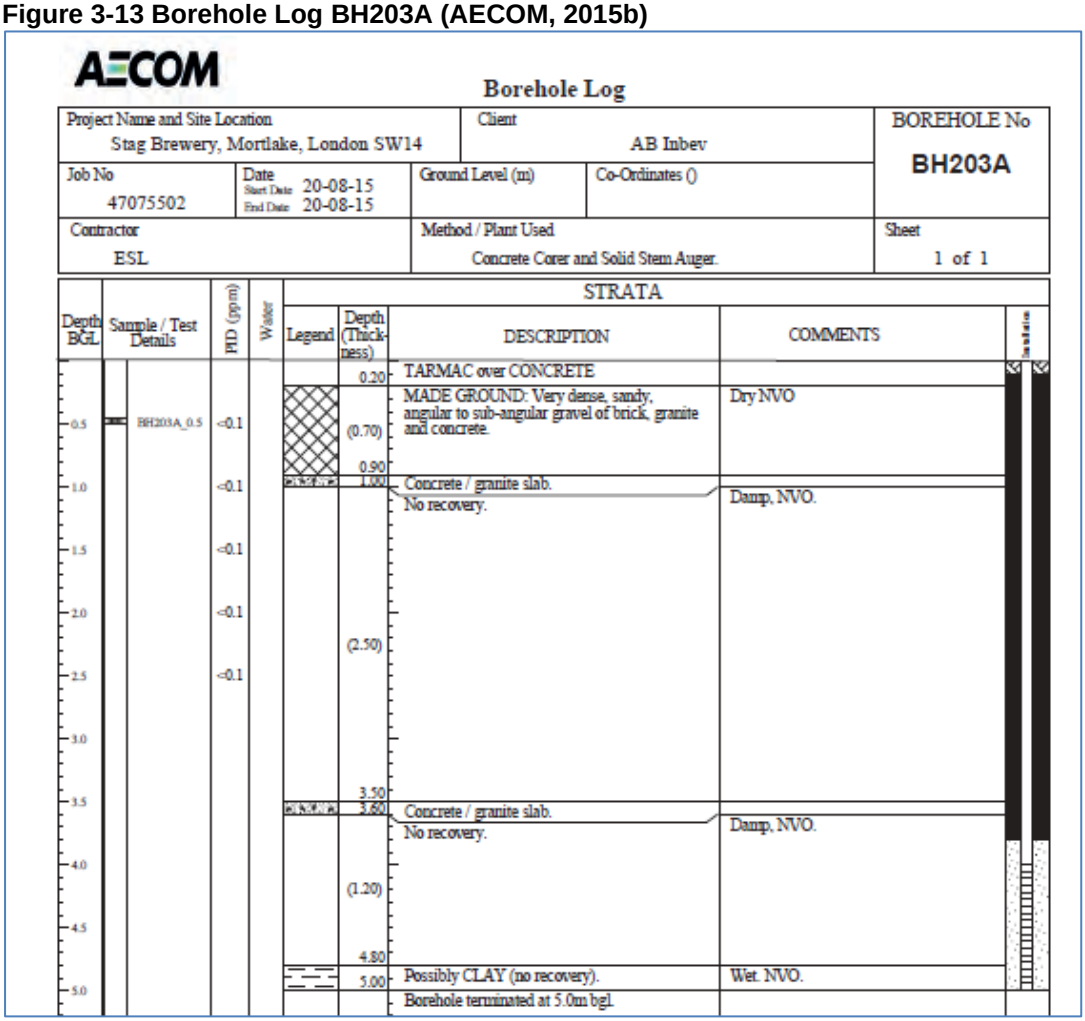
Job No	Date	Ground Level (m)	Co-Ordinates ()
47075502	Start Date 20-08-15 End Date 20-08-15		

Contractor	Method / Plant Used	Sheet
ESL	Concrete Corer and Solid Stem Auger.	1 of 1

STRATA

Depth BGL	Sample / Test Details	PID (ppm)	Water	Legend	Depth (Thickness)	DESCRIPTION	COMMENTS
					0.20	TARMAC over CONCRETE	
0.5		<0.1			(0.70)	MADE GROUND: Very dense, sandy, fine-medium, angular-subangular gravel of yellow and red brick, granite and concrete.	Dry NVO
					0.90		
					1.00	Concrete / possible granite slab.	
					(2.00)	No recovery.	
					3.00		
						Borehole terminated at 3.0m bgl due to refusal on concrete.	

Figure 3-13 Borehole Log BH203A (AECOM, 2015b)



AECOM

Borehole Log

Project Name and Site Location	Client	BOREHOLE No
Stag Brewery, Mortlake, London SW14	AB Inbev	BH203A

Job No	Date	Ground Level (m)	Co-Ordinates ()
47075502	Start Date 20-08-15 End Date 20-08-15		

Contractor	Method / Plant Used	Sheet
ESL	Concrete Corer and Solid Stem Auger.	1 of 1

STRATA

Depth BGL	Sample / Test Details	PID (ppm)	Water	Legend	Depth (Thickness)	DESCRIPTION	COMMENTS
					0.20	TARMAC over CONCRETE	
0.5	BH203A_0.5	<0.1			(0.70)	MADE GROUND: Very dense, sandy, angular to sub-angular gravel of brick, granite and concrete.	Dry NVO
					0.90		
1.0		<0.1			1.00	Concrete / granite slab.	
						No recovery.	Damp, NVO.
1.5		<0.1					
2.0		<0.1			(2.50)		
2.5		<0.1					
3.0							
3.5					3.50		
					3.60	Concrete / granite slab.	
						No recovery.	Damp, NVO.
4.0					(1.20)		
4.5							
					4.80		
5.0					5.00	Possibly CLAY (no recovery).	Wet. NVO.
						Borehole terminated at 5.0m bgl.	

3.3.3 Sewers

Although surface water and foul sewers are laid under the Site, Thames Water have confirmed that there are no recorded historic sewer flooding records at the Site (Reference to their response to Waterman IE dated January 2016), extracts from which are shown in Appendix E

3.3.4 Surface Water

Surface water flooding can occur with ponding in low areas of the Site and surrounding area where the drainage is unable to deal with the incident rainfall. Surface water flood risk is available in the SFRA (LBRuT, 2016c) (Figure 3-14) and from the Environment Agency Web site (Figure 3-15). The latter shows that, for the low-risk scenario, the depths vary from 0 to about 300 mm along the Lower Richmond Road and Mortlake High Street to the east of the existing Sports Ground, as indicated on the map. Greater depths of surface water flooding are predicted in Lower Richmond Road adjacent to the Sports Ground (300 to 900 mm) and in the park, south of the Lower Richmond Road (in excess of 900 mm). Some of the surface water flooding on Lower Richmond Road may be linked to the blocked gully incidents (Figure 3-16). For the high-risk scenario, predicted surface water flooding is restricted to the carriageway of the Upper Richmond Road and the adjacent park and is of shallow depth.

Figure 3-14 Surface Water Map (LBRuT, 2016c)

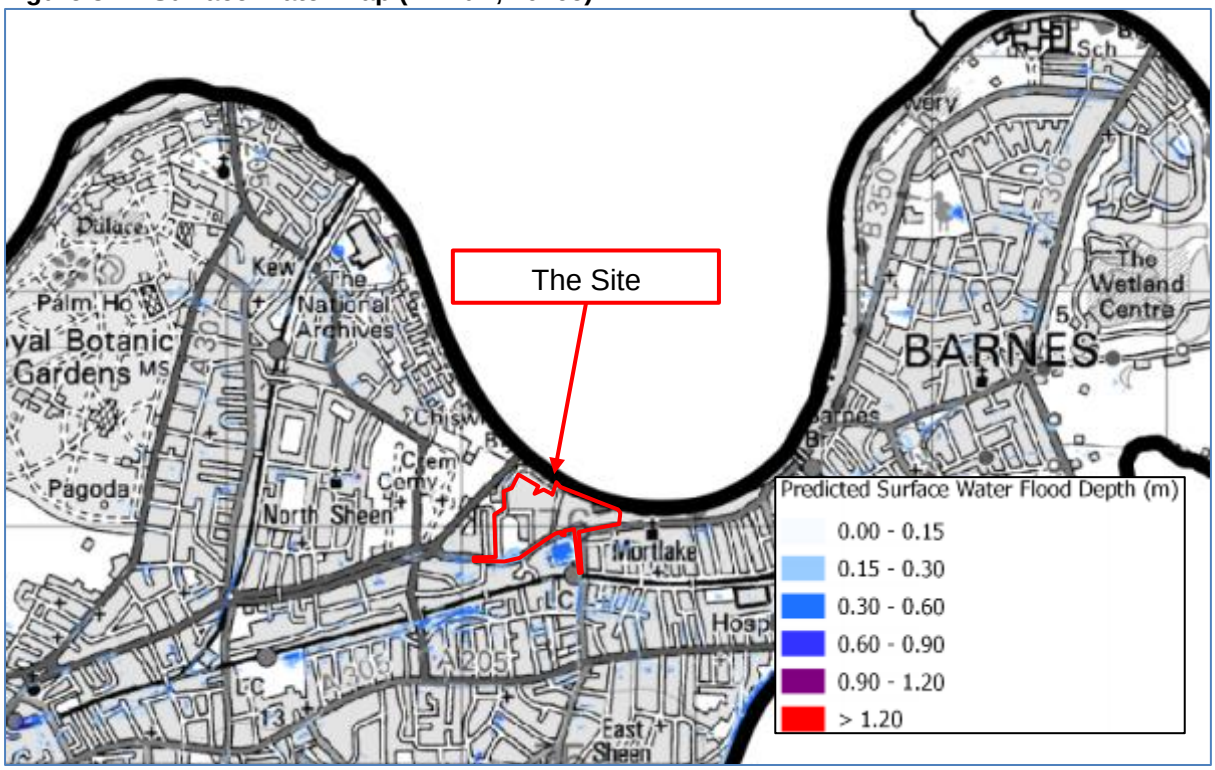
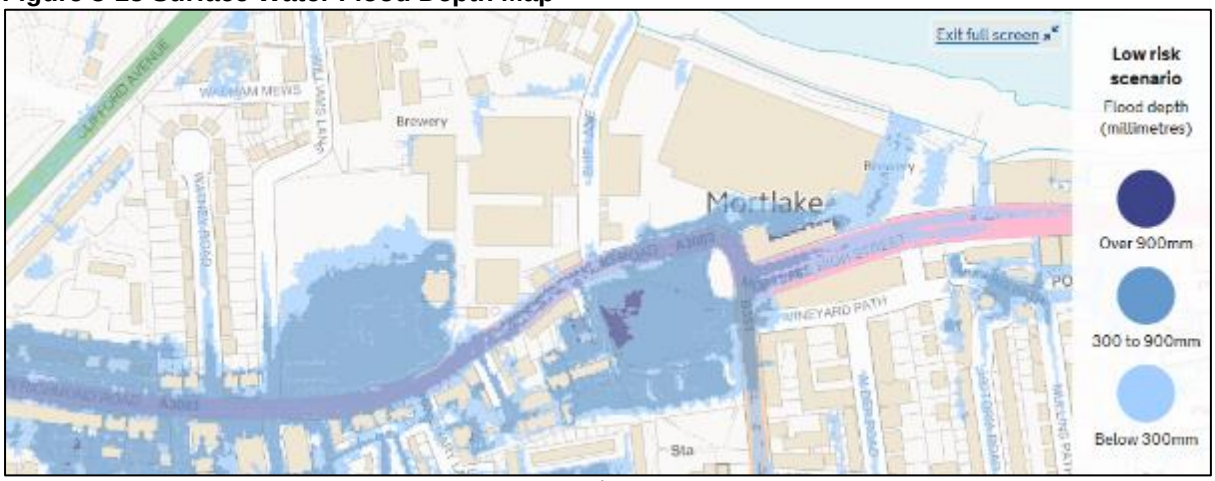
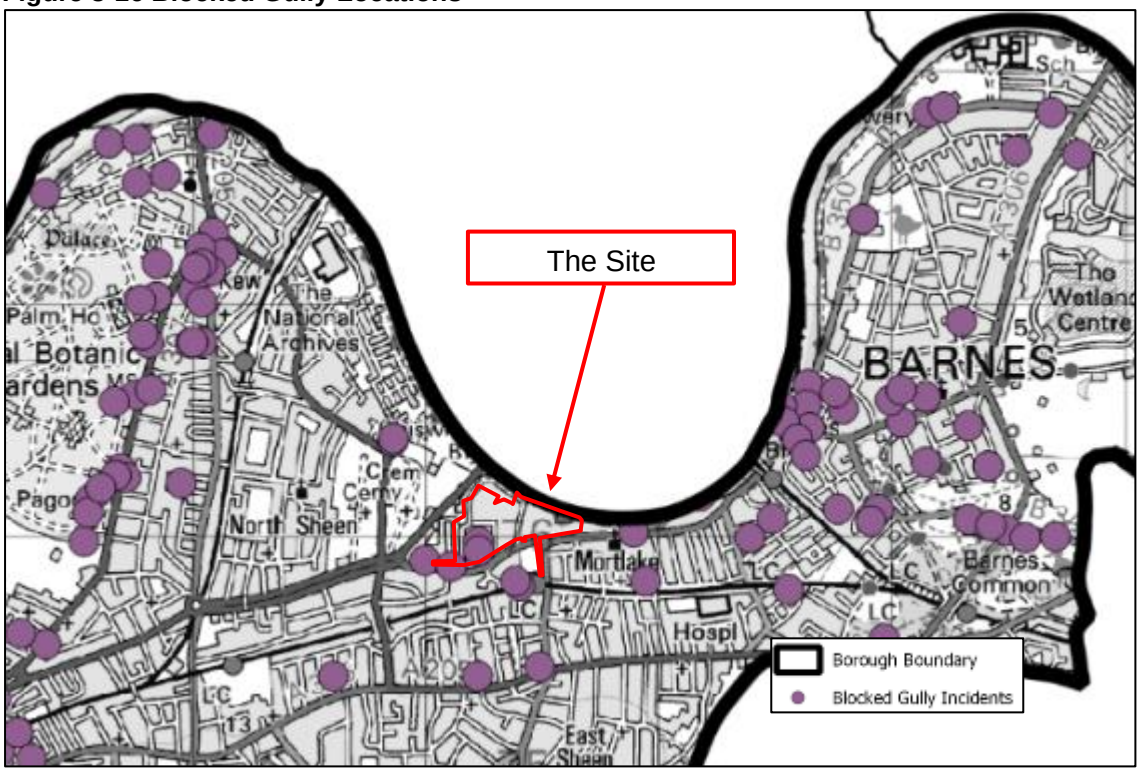


Figure 3-15 Surface Water Flood Depth Map



Environment Agency Web Site (Accessed 23rd October 2017)

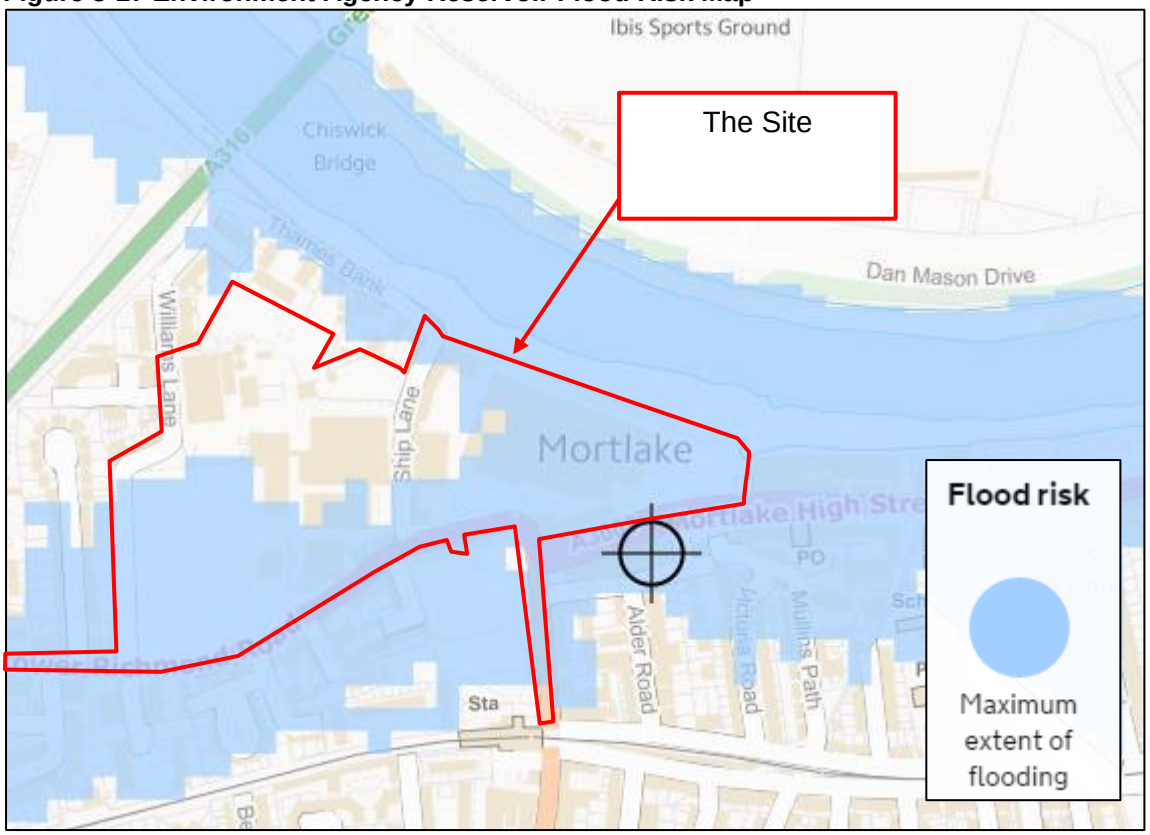
Figure 3-16 Blocked Gully Locations



3.3.5 Infrastructure

The Site has a potential risk of flooding from the Queen Elizabeth II reservoir and the Queen Mary reservoir in Surrey (Figure 3-17). This could occur if the reservoirs were to fail, causing water to flood over the western and southern parts of the Site. However, these reservoirs located over 20 km upstream of the Site, they are managed and maintained by Thames Water and the risk of reservoir flooding is considered to be very low.

Figure 3-17 Environment Agency Reservoir Flood Risk Map



3.4 Existing Surface Water Drainage Arrangements

During the preliminary investigations for this Site, Waterman IE made a Developer Enquiry to Thames Water in respect of sewers and water mains. Extracts from the response in January 2016 are provided in Appendix E . These drawings show a variety of combined, surface and foul sewers around the Site. Whilst sewers traverse the Site along both Ship Lane and Bull's Alley, none are shown on the operational area of the former brewery.

The on-site drainage measures were inspected during the site visit in 16th June 2016. Virtually the entire Site comprises either rooves or hard standing (Figure 3-18). Roof drainage was via downpipes that are believed to outfall to the Thames whilst hard standing drains (Figure 3-19). runoff calculations are presented in the Drainage Strategy (Waterman IE, 2019).

Figure 3-18 General views of The Site

a) West **b) East**

Figure 3-19 Examples of drainage

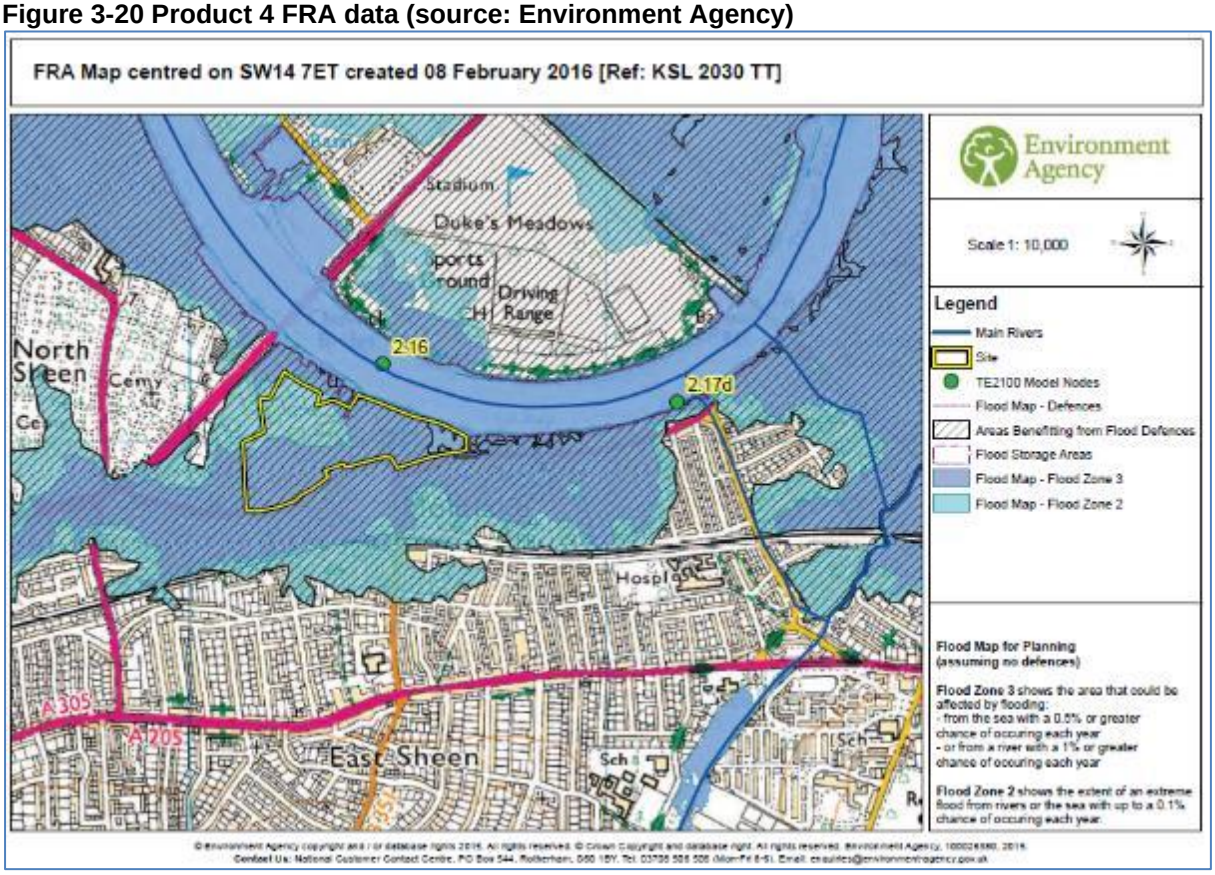
a) Roof **b) Hard standing**

3.5 Probability of Site Flooding

The assumed tidal water levels of the River Thames are based on the TE2100 model node 2.16 (Figure 3-20) which is adjacent to the Site. The modelled levels for node 2.16 are assumed to apply along the entire river frontage due to the river's shallow gradient.

The probability of the Site flooding due to the tides is limited by the tidal defences to protect up to a 0.1% Annual Exceedance Probability (AEP) event. However, there remains a risk from flood defences failing, with the outcomes being modelled on behalf of the Environment Agency, which has been provided as Product 4 data. This provides flood levels for the floodplain nodes in Figure 3-21 for different scenarios of flood defence failure.

Figure 3-20 Product 4 FRA data (source: Environment Agency)



An identical map was provided with the July 2017 Product 4 data set
This map shows a site boundary that has now been superseded.

The relevant levels have been provided by the Environment Agency for a range of return periods and projections. The most recent levels provided by the Environment Agency are from the following sources:

- TE2100 modelled node 2.16;
- Thames Breach Modelling; and
- Thames Tidal Upstream Inundation Modelling.

The TE2100 levels result from a large body of work commissioned by the Environment Agency in relation to flood risk management of the Thames Estuary. The operation of the Thames Barrier is critical in this strategy and the recent modelling addresses the frequency of Thames Barrier operation. The Thames Barrier manages tidal flood events up to a 0.1% AEP event. These TE2100 levels recently provided do not have return periods. The Environment Agency present them as "absolute maximum levels" and clarify this as follows:

> "*The levels upstream of the barrier are the highest levels permitted by the operation of the Thames Barrier. If levels and flows are forecast to be any higher, the Thames Barrier would shut, ensuring that the tide is blocked and the river maintained to a low level. For this reason, the probability of any given water level upstream of the Barrier is controlled and therefore any associated return period becomes irrelevant. The Thames Barrier and associated defence system has a 1 in 1000 year standard which means it ensures that flood risk is managed up to an event that has a 0.1% annual probability. The probability of water levels upriver is ultimately controlled by the staff at the Thames Barrier.*"

The modelled levels (Table 3-2) for the Site indicate that water levels in 2100 should reach a maximum level of 6.03 m. However, minimum bank defence levels should currently be built to 5.94 m and allow for a rise to 6.70 m.

Table 3-2 Modelled levels for TE2100 node 2.16

Year	Attribute	Level (m)
2008 levels	Extreme water level	5.23
	Right bank defence	5.94
	Allow for future defence raising to:	6.70
2065 to 2100	Design water level	5.62
	Bank defence level	6.25
2100	Design water level	6.03
	Defence level	6.70

These data are from the Product 4 data set provided in 2016. Model data for node 2.16, the most appropriate node for the site, was not provided with the Product 4 data in 2017. However, the model data for other model nodes was unchanged in the more recent product 4 data set.

Modelled levels for the nodes shown in Figure 3-21 are also provided for tidal breach modelling at the Site where the flood defences at the Site are breached. The breaches in the defences were considered to be 20 m wide for composite defences and 50 m wide for soft defences (not relevant here). The model outputs are shown in Figure 3-22 and Table 3-3. These show that a breach of the defences would cause water to flood the south-east area of the Site in the present day. The flood extents would increase westwards and northwards in 2055 and 2100, with an increase in tidal breach levels up to 6.02 mAOD in the east of the site.

Two sets of maps are provided in the Figures and Tables:

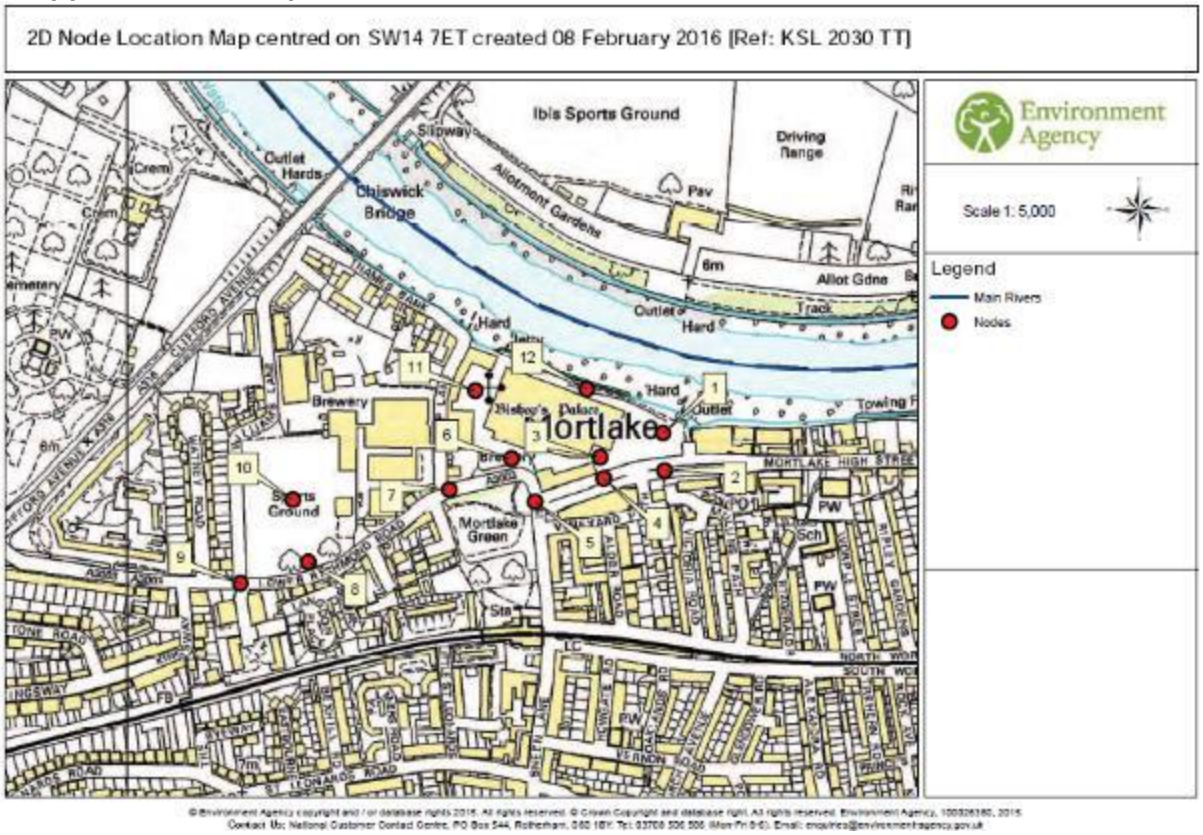
(a) Refers to the Product 4 data provided in 2016; and
(b) Refers to Product 4 data provided in 2017.

A different set of nodes has been provided with each set of Product 4 data. However, a comparison of levels for corresponding locations has been made in Table 3-4. This shows that nodes close to the breach (i.e. towards the eastern part of the site) have lower peaks for the more recent modelling. Conversely, nodes in the western part of the site have higher levels for the more recent modelling. It has not been possible to discuss these findings with the Environment Agency modellers. However, it seems to show that the more recent modelling has enabled flood water to propagate more rapidly away from the breach. This likely reflects model assumptions about the movement of the flood wave through the urban extent. It also contributes to a larger area being affected by the breach in 2100 than was shown in the previous modelling and Product 4 data.

It should be noted that the Environment Agency modelling uses the existing site layout. The landscaping that is proposed as part of the development of the Site will have a profound impact on the flood extents associated with breach. It is shown in Appendix D that the development of the Site will lead to a general reduction in flood extents and flood levels resulting from a breach. This is partly due to the blocking of flow paths by the proposed landscaping and the reduced opportunity for breach following the development.

Figure 3-21 Environment Agency 2D Node Locations

(a) Product 4 data provided in 2016



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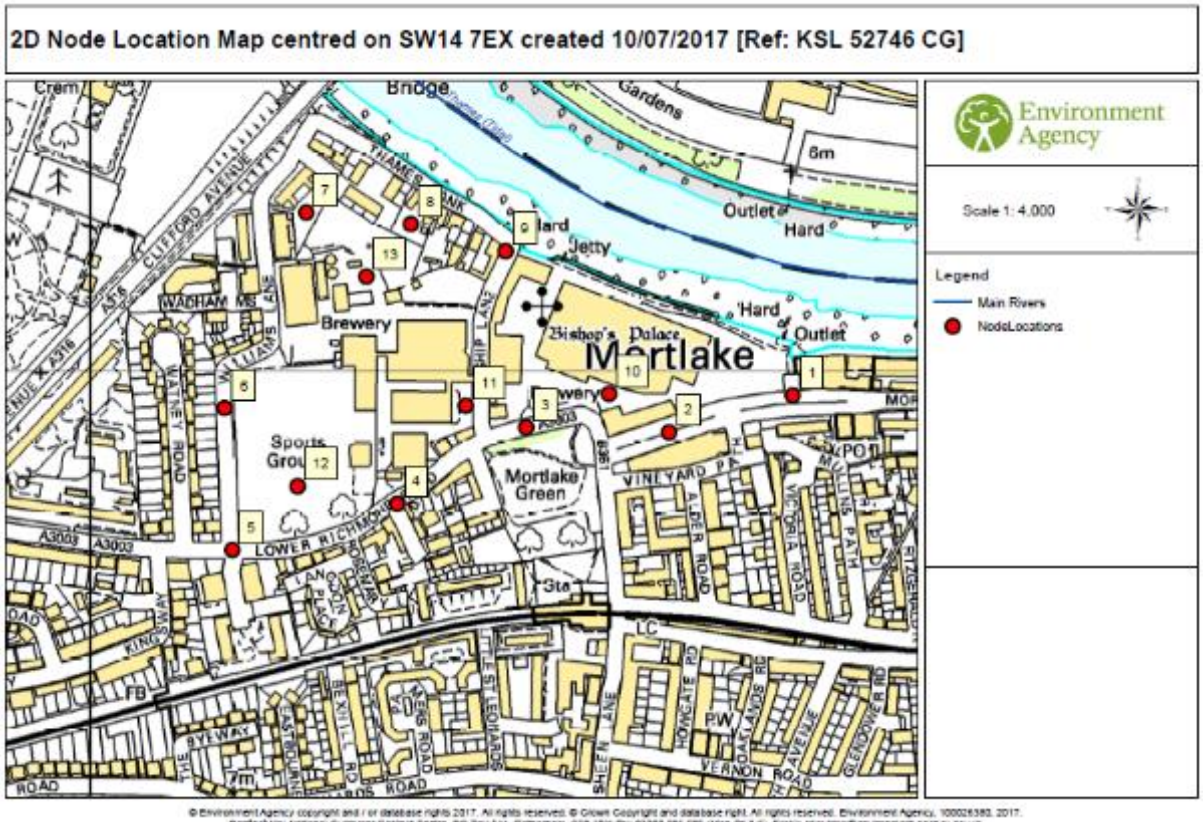
Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

(b) Product 4 data provided in 2017



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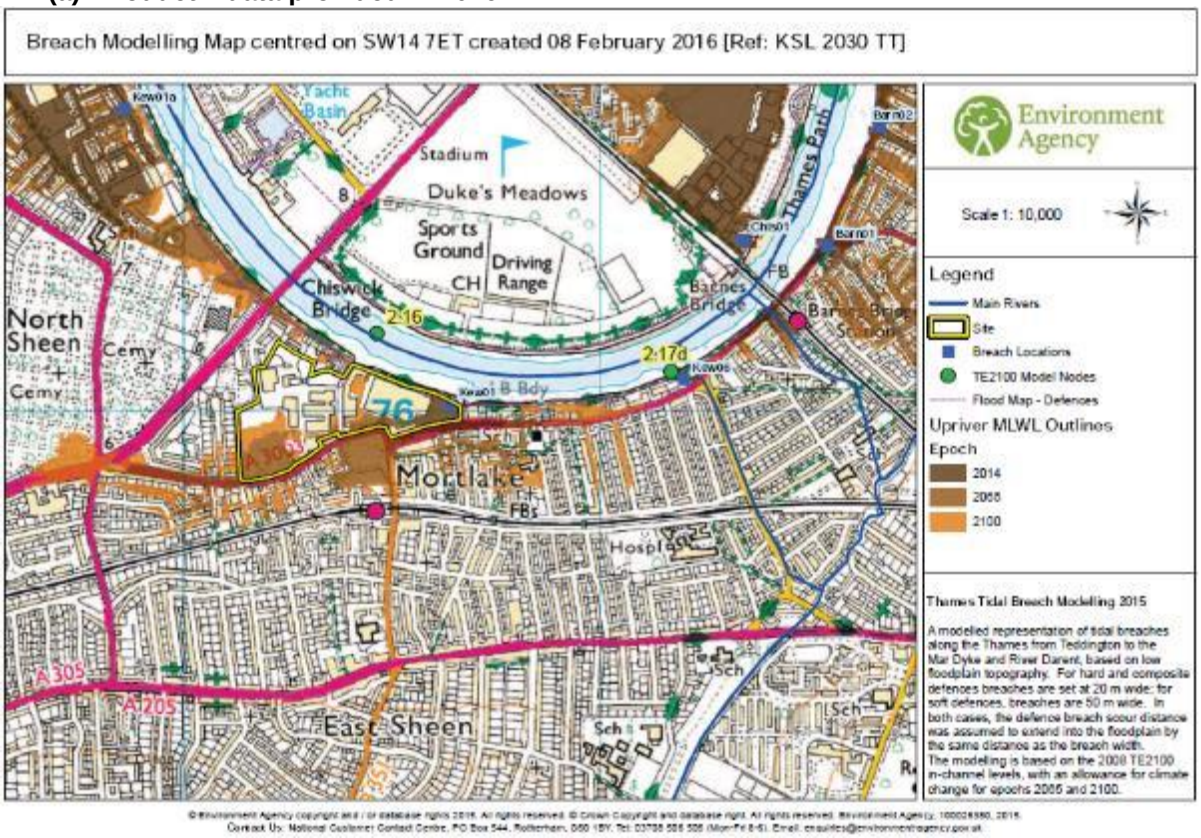
Contact Us: National Customer Contact Centre, PO Box 544, Rotherham, S60 1BY. Tel: 03708 506 506 (Mon-Fri 8-6). Email: enquiries@environment-agency.gov.uk

Figure 3-22 Environment Agency Breach Model Map

(a) Product 4 data provided in 2016



(b) Product 4 data provided in 2017

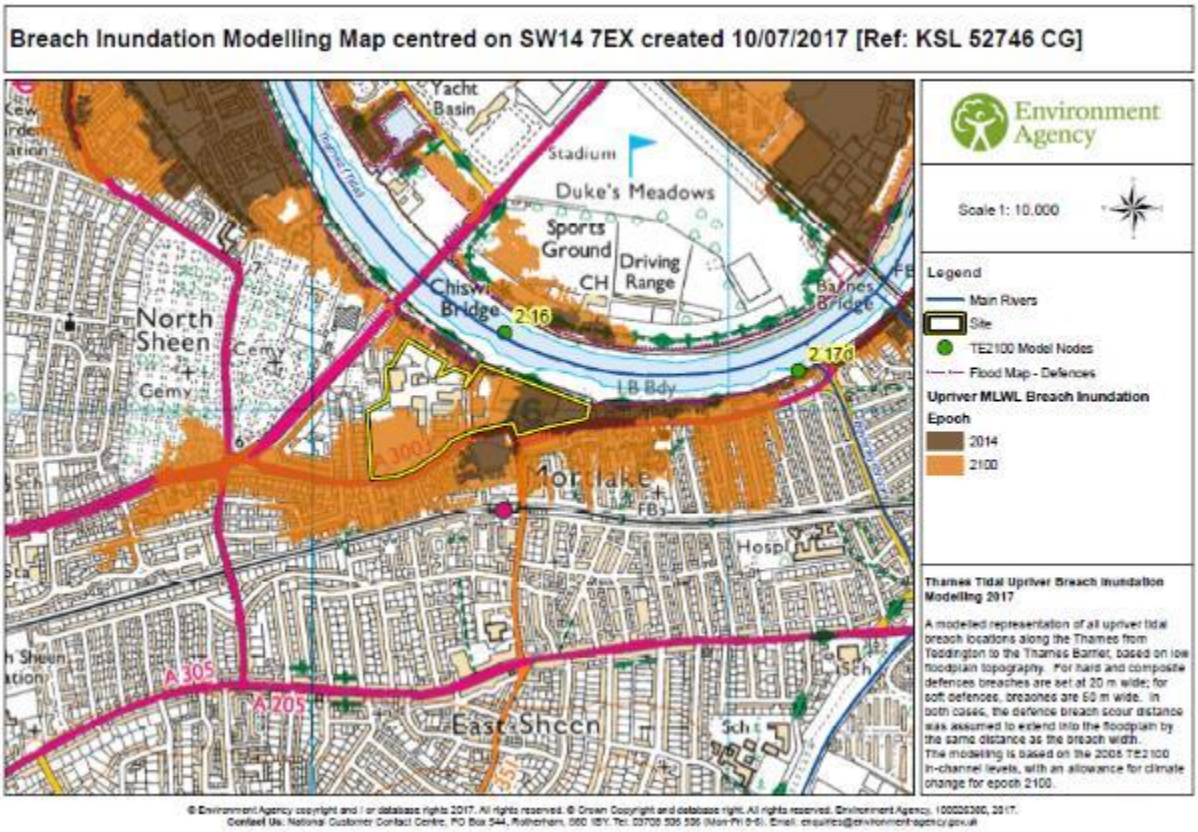


Table 3-3 Environment Agency Thames Tidal Breach Levels

(a) Product 4 data provided in 2016

			KEW01		
	National Grid Reference		Modelled levels in mAODN		
Node	Easting	Northing	2014	2065	2100
1	520639	176008	5.24	5.77	6.02
2	520641	175963	5.23	5.77	6.02
3	520564	175979	5.23	5.77	6.02
4	520568	175953	5.23	5.77	6.02
5	520486	175926	Nil Return	5.76	6.00
6	520458	175977	Nil Return	5.76	6.00
7	520384	175940	Nil Return	5.76	6.00
8	520215	175854	Nil Return	5.29	5.63
9	520134	175828	Nil Return	5.28	5.63
10	520197	175928	Nil Return	5.29	5.63
11	520415	176058	Nil Return	Nil Return	6.02
12	520548	176060	5.23	5.77	6.02

(b) Product 4 data provided in 2017

	National Grid Reference		Modelled levels in mAODN for Max Likely Water Level	
Node	Easting	Northing	2014	2100
1	520672	175977	5.20	5.99
2	520553	175941	Nil Return	5.96
3	520416	175946	5.06	5.93
4	520293	175873	-1.00	5.80
5	520135	175829	-1.00	5.79
6	520128	175964	-1.00	5.78
7	520206	176151	-1.00	6.03
8	520306	176140	Nil Return	6.03
9	520397	176115	5.27	6.03
10	520496	175978	5.13	5.95
11	520359	175967	Nil Return	5.91
12	520198	175890	-1.00	5.79
13	520264	176090	Nil Return	Nil Return

Table 3-4 Comparison Tidal Breach Levels from successive models

Node (2016)	2100 Peak (mAOD)	Node (2017)	2100 Peak (mAOD)	Change	Comment
2	6.02	1	5.99	-0.03	Mortlake Rd: Eastern part of site
4	6.02	2	5.96	-0.06	"
6	6.00	10	5.95	-0.05	"
7	6.00	3	5.93	-0.07	"
9	5.63	5	5.79	+0.16	SW corner of Sports ground
10	5.63	12	5.79	+0.16	Sports Ground
12	6.02	9	6.03	+0.01	North end of Ship Lane

Red denotes an increase in flood levels with the most recent Product 4 data in 2017; green denotes a decrease.

Further modelling conducted by the Environment Agency assessed the flood levels and flood extents if all the linear flood defence infrastructure along the River Thames is to fail while the Thames Barrier remains operational. This is a truly extreme combination of circumstances. These model results are based on data from the TE2100 in-channel levels from 2008. The outputs of this model are shown in Figure 3-23 and Table 3-5. This shows a larger flood extent than the breach model map, particularly around the eastern area of the site next to the River Thames. However, the flood levels are similar with a maximum level of 6.03 m at nodes 11

and 12. Note that identical flood extents were provided for the two sets of Product 4 Data provided in 2016 and 2017.

Figure 3-23 Environment Agency Upstream Inundation Model Map

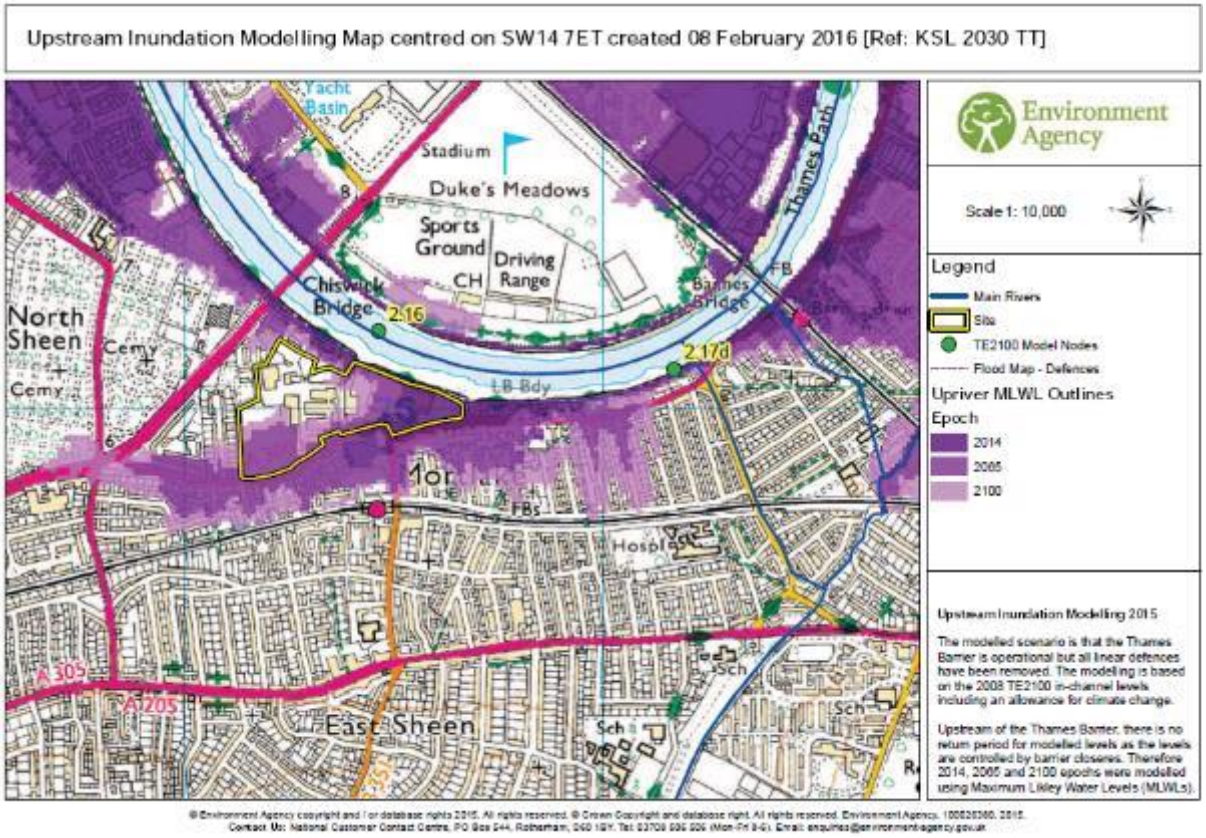


Table 3-5 Environment Agency Upstream Inundation Modelled Levels

	National Grid Reference		Modelled levels in mAODN		
Point	Easting	Northing	2014	2065	2100
1	520639	176008	5.17	5.74	6.00
2	520641	175963	5.18	5.75	6.01
3	520564	175979	5.19	5.74	6.01
4	520568	175953	5.19	5.74	6.01
5	520486	175926	5.01	5.72	5.97
6	520458	175977	Nil Return	5.72	5.97
7	520384	175940	Nil Return	5.72	5.97
8	520215	175854	Nil Return	5.33	5.63
9	520134	175828	Nil Return	5.31	5.60
10	520197	175928	Nil Return	5.33	5.63
11	520415	176058	Nil Return	Nil Return	6.03
12	520548	176060	5.23	5.78	6.03

4. Review of Development Proposals

4.1 Development Process

The location and general description of the Site has been provided in Section 2.1. In broad terms, it comprises:

- The Site, being the 9.25 ha parcel of land, occupied by a mix of large scale industrial brewery structures and buildings, hardstanding and a playing field in the south west known as Watney's Sports Ground, and incorporating a section of the River Thames towpath within the north of the Site, plus sections of surrounding roads;.

The boundaries of the Site Components is shown in Figure 4-1. This FRA is focused almost exclusively on the Site, since the S278 works at Chalkers Corner has no implications for the flood risk assessment, other than in relation to the breach analysis presented in Appendix D .

The Site is bisected by Ship Lane, which runs in a north-south orientation between the River Thames and the Lower Richmond Road. Permission is sought in detail for works to the **east** of Ship Lane as follows for Application A:

a) Demolition of existing buildings (except The Maltings and the façade of the Bottling Plant and former Hotel), walls, associated structures, site clearance and groundworks
b) Alterations and extensions to existing buildings and erection of buildings varying in height from 3 to 10 storeys plus a single storey basement (with sub-basement under Building 01)
c) 576 residential apartments
d) Flexible use floorspace for:
i. Retail, financial and professional services, café/restaurant and drinking establishment uses
ii. Offices
iii. Non-residential institutions and community use
iv. Boathouse
e) Hotel / public house with accommodation
f) Cinema
g) Offices
h) New pedestrian, vehicle and cycle accesses and internal routes, and associated highway works
i) Provision of on-site cycle, vehicle and service parking at surface and basement level
j) Provision of public open space, amenity and play space and landscaping
k) Flood defence and towpath works
l) Installation of plant and energy centres

Redevelopment of the Site to the **west** of Ship Lane provides residential units (including affordable housing), car parking, and a secondary school.

a) The erection of a single storey basement and buildings varying in height from 3 to 7 storeys
b) Residential development of up to 674 units
c) Provision of on-site cycle, vehicle and service parking
d) Provision of public open space, amenity and play space and landscaping
e) New pedestrian, vehicle and cycle accesses and internal routes, and associated highway works

No amendments are proposed to the description of development for Application B.

No amendments are proposed to the description of development for Application C. Works at Chalkers Corner are now proposed to be carried out solely on Highways Land and under Section 278 of the Highways Act 1980.

The Master Plan is shown in Figure 4-2.

Figure 4-1 Site Boundary

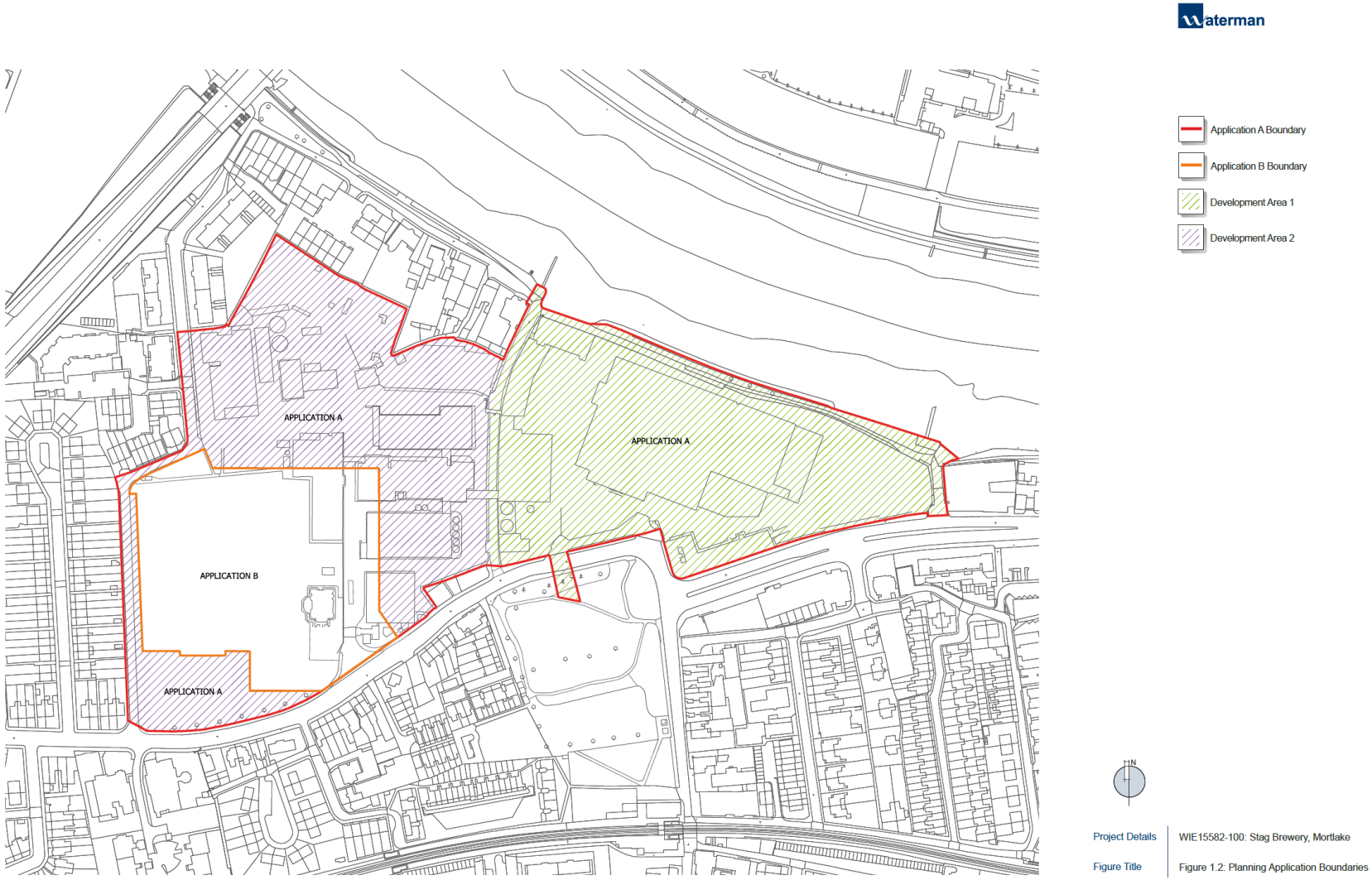
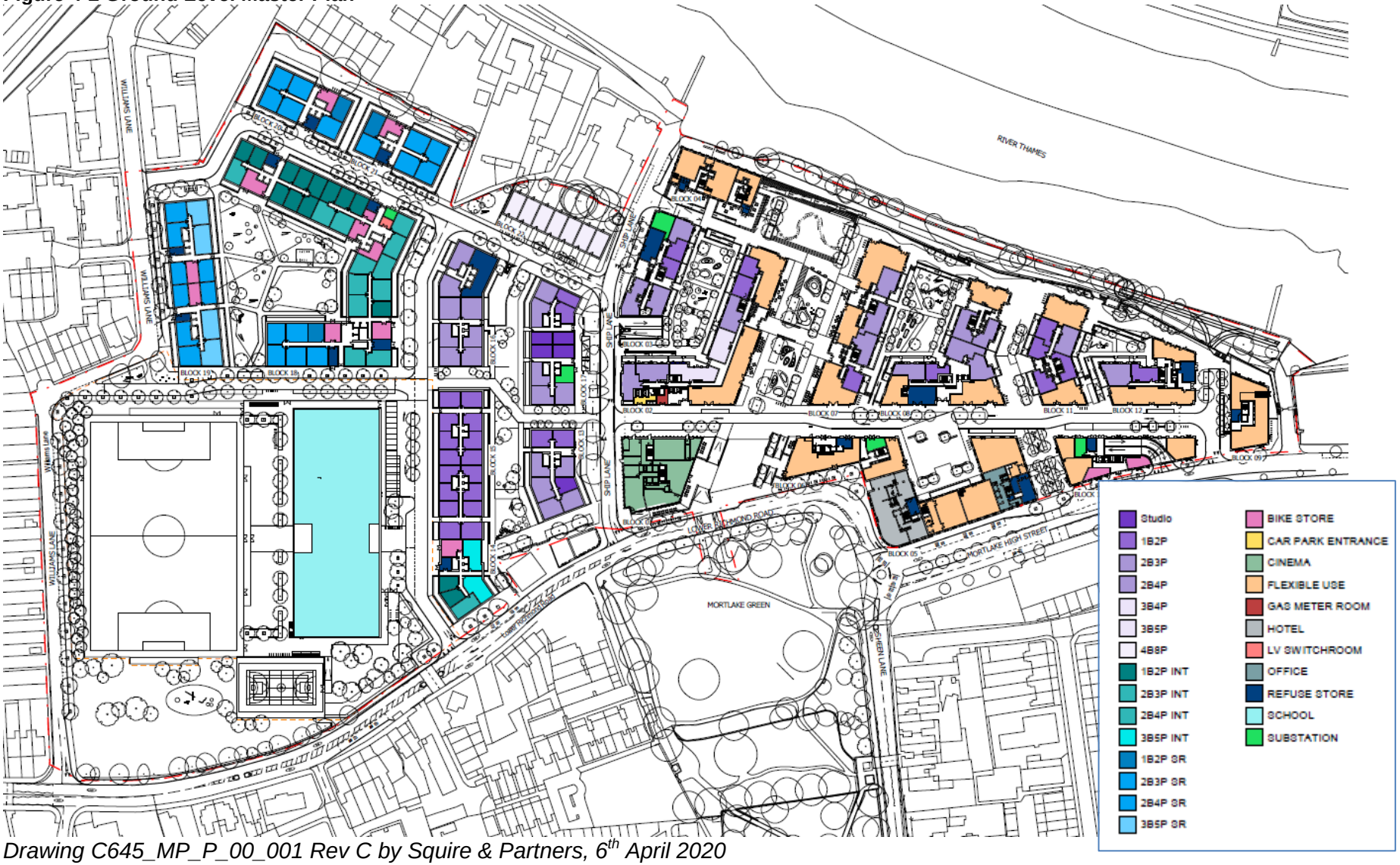


Figure 4-2 Ground Level Master Plan



Drawing C645_MP_P_00_001 Rev C by Squire & Partners, 6th April 2020

4.2 Flood Risk Management Measures

4.2.1 General

It is a requirement that any development in flood risk areas leads to a development that is safe for all users of the Site. This Section reviews the ways in which the development will be made safe from the effects of flooding.

4.2.2 Tidal Defences

(a) General

The existing tidal defences are shown in Figure 4-4 along with photos taken during the Site visit on 16th June 2016. For the most part, the defences comprise residual walls from buildings, the majority of which have been demolished. The major exceptions to this are where the defences are formed by the external walls of "The Maltings" and along Ship Lane. Along Ship Lane, the defences are formed for the most part by the perimeter walls of the site. Ship Lane rises away from the River, and the road surface forms part of the defence line some 50 m from the river bank (Figure 4-3).

Figure 4-3 Extract from the Environment Agency's Flood Map for Planning showing tidal flood defences

https://flood-map-for-planning.service.gov.uk/summary/520505/176035

Figure 4-4 The extent of existing tidal defences

Whilst the use of external walls of buildings is not ideal for tidal defences, this does and has provided a reasonable level of flood defence. The current condition of the defences is rated by the Environment Agency as 2 which is "good" on a scale of 1 (very good) to 5 (very poor). However, a river wall condition survey undertaken by Waterman IE in September 2016 for a 368 m stretch of the River Thames wall along the northern boundary of the Site found the river wall to be in a poor to fair condition (Waterman IE, 2016a). The defences are inspected twice a year by the Environment Agency. However, it is the **riparian owners' responsibility** to ensure that they are maintained to the statutory Defence Level (currently 5.94 mAOD). The towpath and riverbank are under the ownership of the Port of London Authority (PLA).

The Development has provided a clear opportunity for remodelling of the tidal defences. This will improve the performance of the defences and provide benefits to the Site and surrounding area. It will also provide an opportunity for enhancement of the connection between the Site and the river, which is currently very poor. This is consistent with the pre-application response from the Environment Agency (Section C.1) "*This is a major riverside development site and an excellent opportunity to improve linkages to the River Thames and quality of the Thames Path in this area"*.

(b) Consultation with Environment Agency

There has been extensive consultation during the development of proposals for the remodelling of the tidal wall. This included two meetings at which proposals for the defences were discussed, namely:

- With the Environment Agency on 26th September 2016;
- With PLA on 13th January 2017.

Valuable feedback was obtained at both meetings and this informed the proposal for the 2018 Planning Application. Comments received in response to the Planning Application were followed by further meetings and a Site Walkover on 3rd December 2018 with staff from WIE. Further responses from the Environment Agency (14th February and 18th July 2019) led to the submission of a Summary Briefing Note by WIE (ref WIE 15582-106-BN-1-2-1-EA) dated 7th August 2019 and which has been agreed by the Environment Agency. The main conclusions of this correspondence are given in Table 4-1.

Table 4-1 Key Conclusions from Consultation with Environment Agency in 2019

Ref	Description
A	The provision of a continuous line of defence at 6.70 mAOD in the vicinity of Bulls Alley with no windows or openings.
B	Whilst future raising of the Bulls Alley defence is not prejudiced, any further discussion on the agreements with the developer may be held post-planning.
C	The confined space that results from the void beneath the Boat Club terrace has a reasonable provision for escape in the event of flooding.
D	The window sills of the Maltings Building (north elevation) will now be at a minimum level of 6.7 mAOD.
E	This is a point of clarification over Ship Lane confirming that there is no existing flood gate at this location.

The general aspects of the agreed layout which are shown in plan view in Figure 4-5 and sectional view in Figure 4-6. This has the following features:

- The crest level of the proposed defences is at a minimum of **6.70 mAOD**. This is the level recommended in the TE2100 Plan for 2100. It is therefore well above the current statutory level and obviates the need for any raising to be undertaken for the foreseeable future.
- The risk of breach in this entire section of refurbished wall is effectively eliminated by the ground raising behind the defences. This provides a very robust defence, requiring only limited maintenance.
- In part, the wall, with crest at 6.13 mAOD, is topped by a 1.1 m high glass balustrade, with effective crest at 7.23 mAOD.
- The alignment is either identical to the existing alignment or is on the "development" side. There is, accordingly, no loss of flood plain storage.
- The proposal will lead to a significant improvement of the towpath; it will be more "open" (see inset images in Figure 4-4), and should provide a more pleasing aspect than is currently the case.
- The proposal provides a **minimum** 4m clear access route on the development side for any access that may be required. The actual standoff is considerably more than this as shown in Figure 4-6. Access is also available to the defences from the towpath.

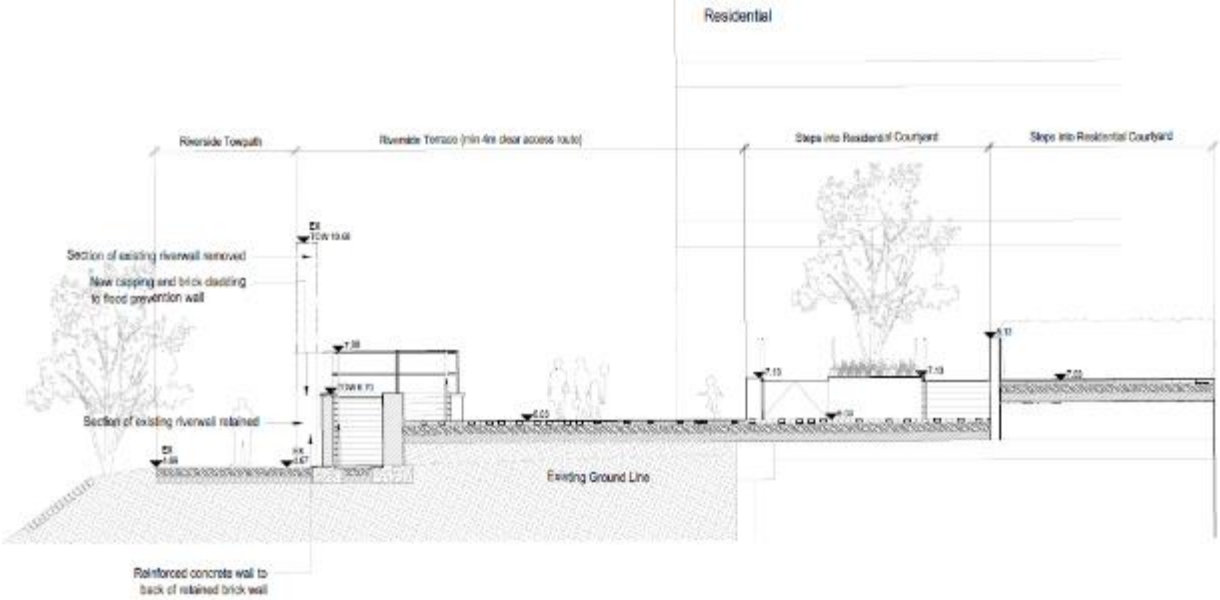
The engineering detail for the walls is shown in Figure 4-7.

Figure 4-5 The proposed arrangement of tidal defences

Drawing by Gillespies, Ref P10736-00-003-GIL-106, Rev D00, dated 19th September 2019

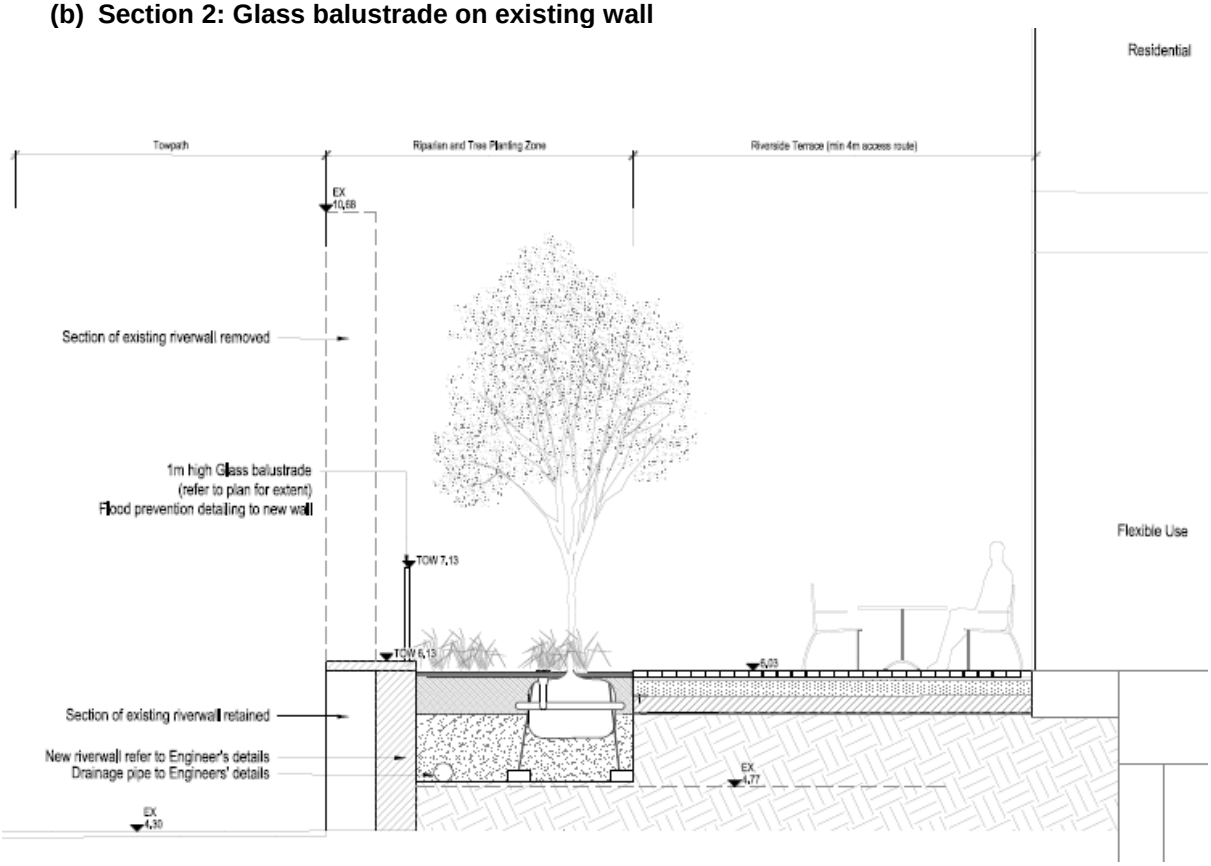
Figure 4-6 Sections of the proposed arrangement of tidal defences

(a) Section 1: New capping and cladding to existing wall



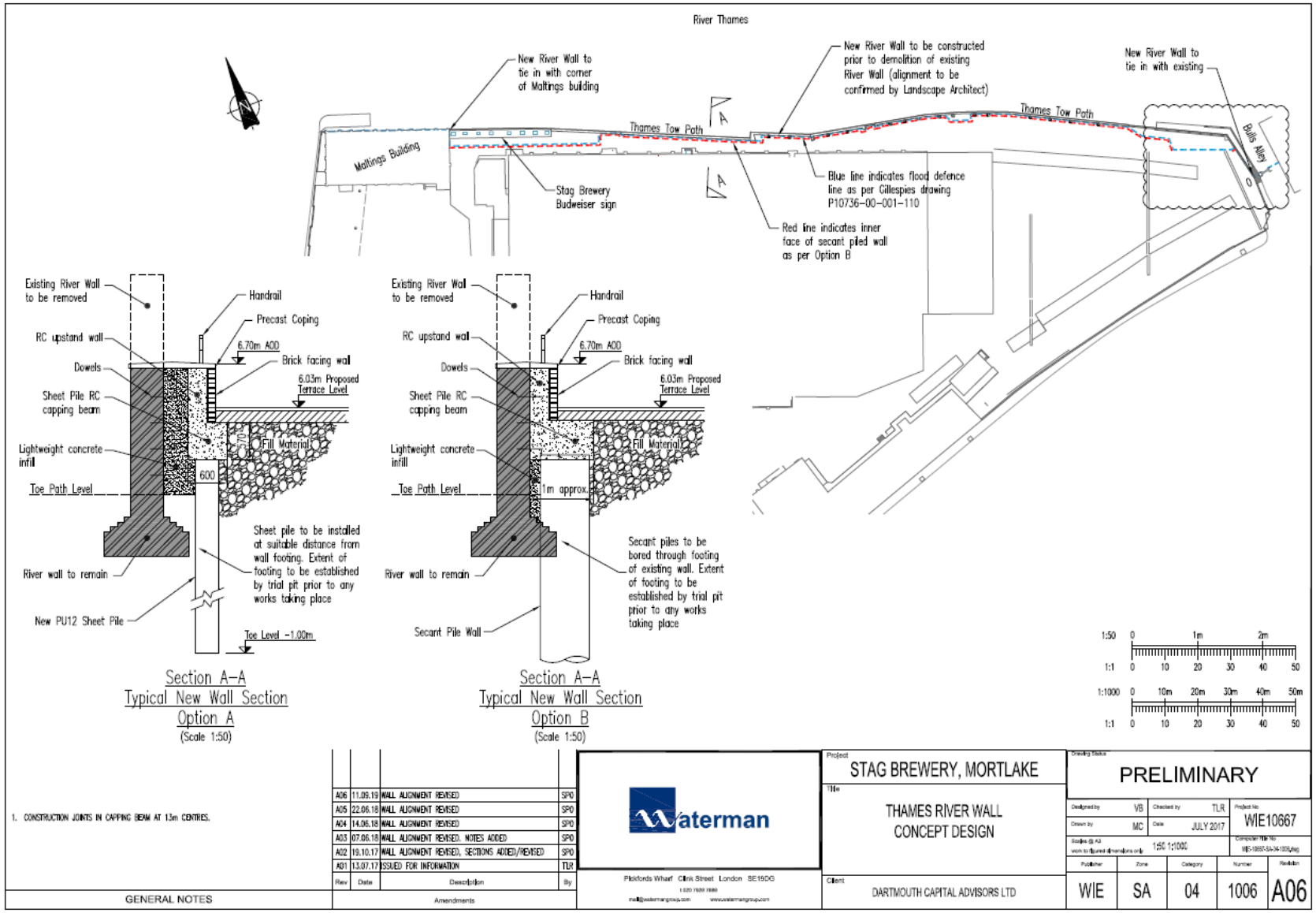
Drawing by Gillespies, Ref P10736-00-001-206

(b) Section 2: Glass balustrade on existing wall



Drawing by Gillespies, Ref P10736-00-001-207

Figure 4-7 Engineering detail for proposed tidal defences



4.2.3 Finished Floor Levels

The proposed Finished Floor Levels (FFLs) and landscaping are shown in Figure 4-9 for the Site (east of Ship Lane) and in Figure 4-18 for the Site (west of Ship Lane). Other than some exceptions, that are discussed later in this Section, the default **minimum ground level for the site is at 6.03 mAOD**, with the **minimum residential FFL at 7.03 mAOD**. This landscaping provides the following:

- A safe level for all residential development with a freeboard of 1 m above the reference flood level;
- A safe level for most commercial development, which will be at or above the reference flood level;
- The provision of dry access within the site with contiguous levels at, or above the reference flood level, with the sole exception of the Maltings;
- The reinforcement of defences, since virtually the entire length of tidal defence is backfilled to the reference flood level.

In summary, therefore the proposed development provides development at a safe level.

The exceptions to this general provision are described below along with relevant mitigation. The relevant buildings have been annotated on Figure 4-9.

Building B01 (Cinema)

The proposed FFL for the cinema is at 5.565 mAOD, with the entrance located on the east side of the building. In the September 2019 revised layout, an Office Reception has been introduced at 5.1 mAOD on the south-west corner of the building. Although the reference flood level for the site has been given as 6.03 mAOD, lower flood levels apply at this location, which is remote from any potential breach. The peak level for Node 3 (Figure 3-21b) is appropriate for this location which has a 2014 peak of 5.06 mAOD and a 2100 peak of 5.93 mAOD (Table 3-3). Furthermore, since the proposed leisure use has a shorter design life, it is appropriate to use modelled flood levels for 2065. Interpolation for this date gives a reference flood level specific to this location of around 5.52 mAOD. This is lower than the FFL for the cinema. Whilst it is slightly higher than the FFL for the Office Reception, there is internal access to the cinema foyer, which is at 5.565 mAOD, as shown in Figure 4-8.

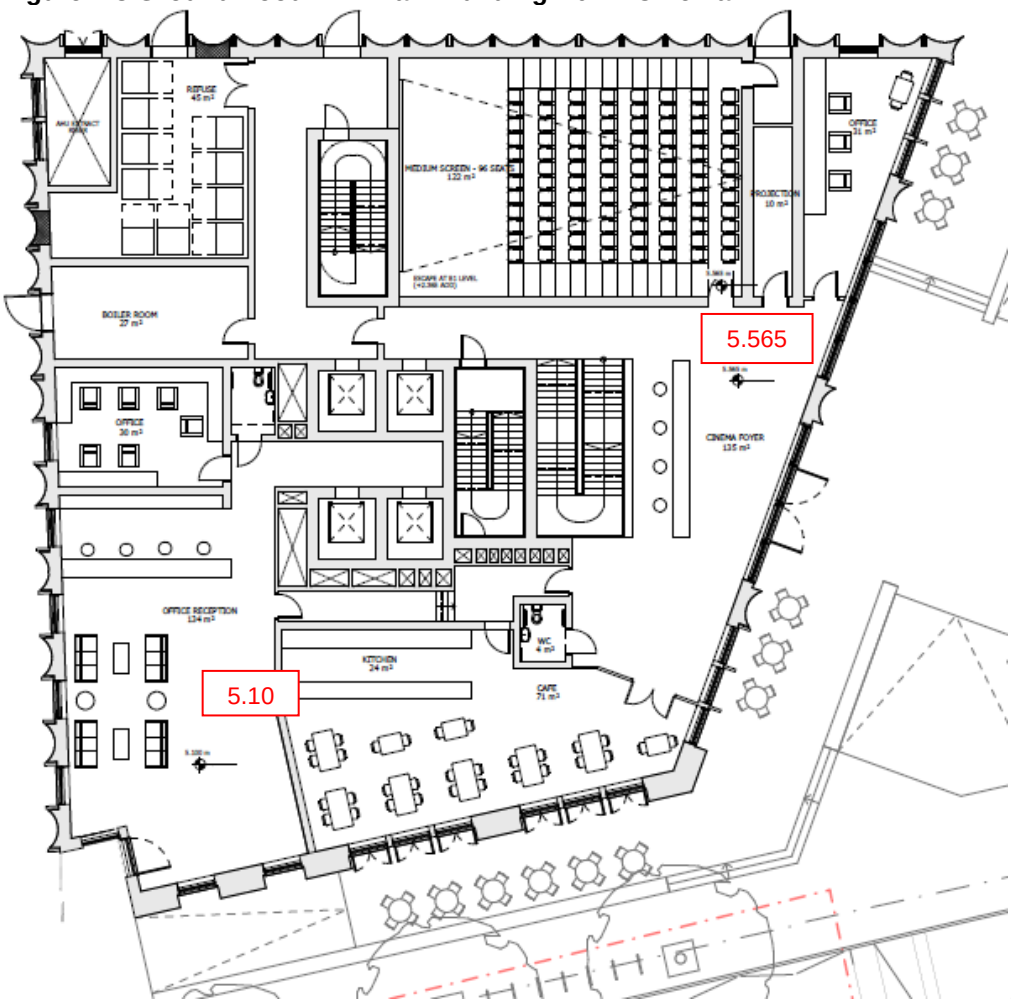
There are 2 Basement Levels; Basement Level 1 gives access to three Cinema screens plus WCs, whilst Basement Level 2 is for Plant Rooms. The entrances to the Basement are at 5.565 mAOD which is above the local flood level. In addition, egress is possible from the basement levels via steps terminating at the cinema foyer at 5.565 mAOD.

Building B04 (The Maltings)

The Maltings is an existing building, within which the FFL for the ground floor has been constrained by the historic building. The FFL for the Flexible use space on the ground floor is at 4.74 mAOD, well below the reference flood level. Furthermore, the exits from the residential properties on the upper floors of the Maltings is at 5.53 mAOD, also below the reference flood level (Figure 4-10). This height was set by the levels above needing to align with the existing windows. The Flexible use is at 4.74 m to align with the towpath and to allow for a more generous floor to ceiling than the residential entrances. The existing basement of the Maltings is in fact lower than this currently.

Although the ground floor of the Maltings and the courtyard to the south are technically below the reference flood level, it is difficult to see how floodwater could affect these areas. This would require a catastrophic failure of the walls of The Maltings. This appears unlikely, given the survey by Waterman IE (2017) (Section 4.2.2). There is no practical risk of a breach affecting this area, given that the relevant tidal defences are provided by landscaped areas or steps as shown also in the drawing by Gillespies (P10736-00-003-GIL-0101) dated 12th August 2019.

Figure 4-8 Ground flood FFL Plan: Building B01 – Cinema

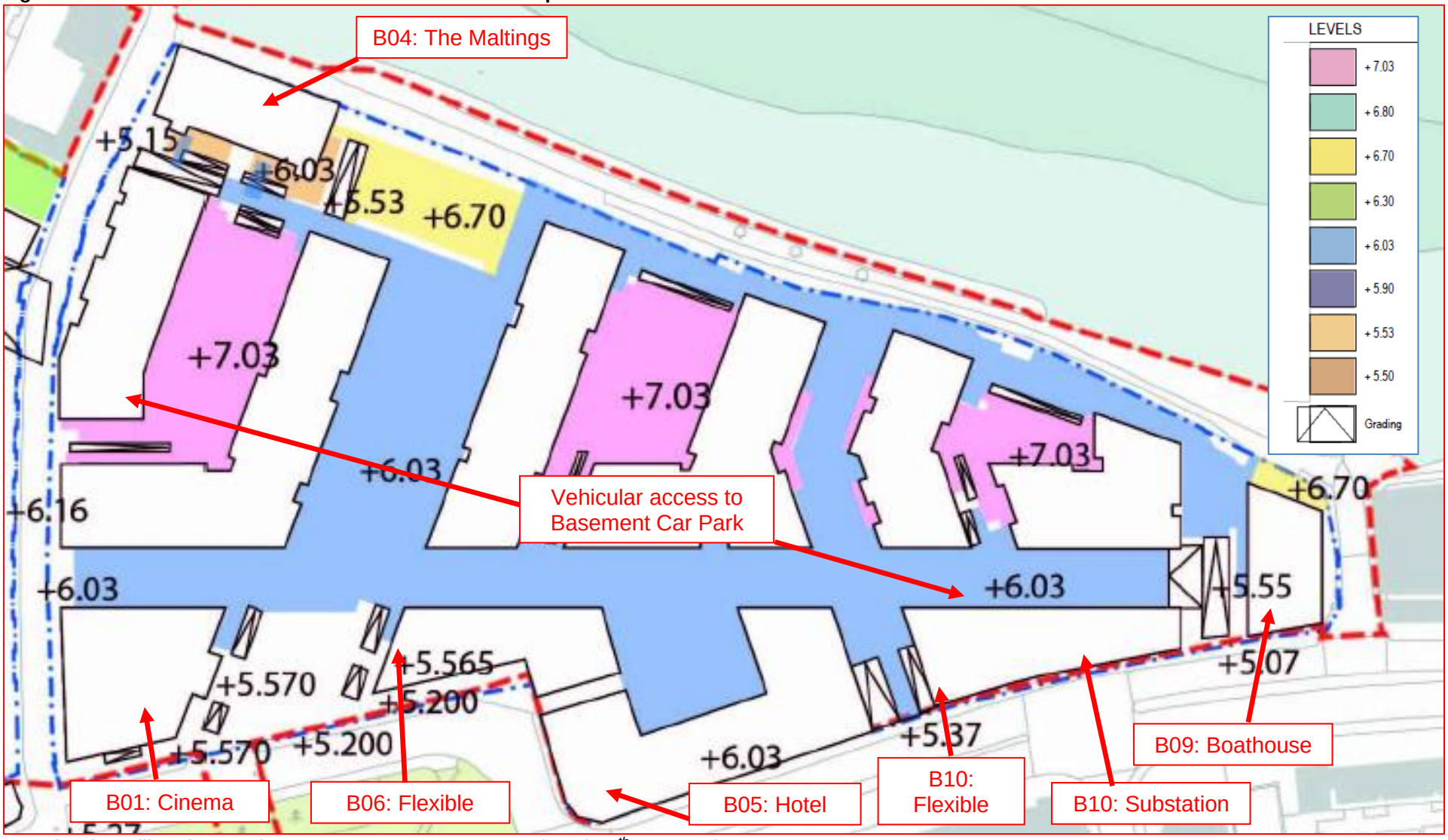


Drawing by Squire & Partners, Ref G200_B01_P_00_001, Rev C, dated 6th April 2020 D
Annotation shows levels in mAOD

Notwithstanding this negligible risk of breach, safe access/egress from The Maltings to land above the reference flood level is available. This is because the maximum depth of water through which it would be necessary to wade would be 0.50 m (6.03 less 5.53 m) and it would be standing water. Strictly, this gives rise to a Hazard Rating (DEFRA & Environment Agency, 2008) of 1.25, rated as “Danger for Some” (Table G-1). However, this includes a “Debris Factor of 1. Since the risk of debris in this location is negligible, a Hazard Rating of 0.25 is more appropriate and this is classed as “Very Low Hazard – Caution”.

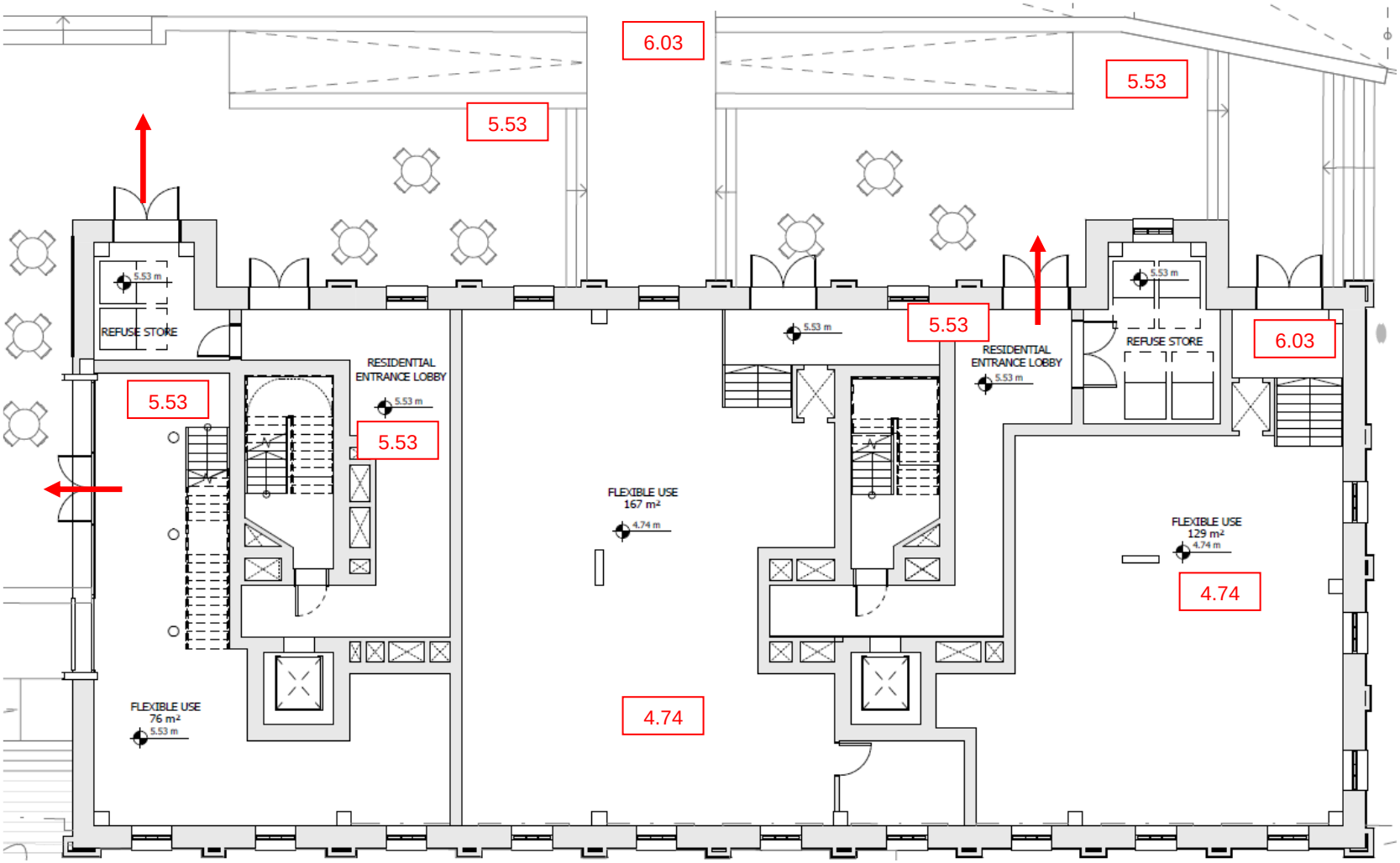
The floor levels and landscaping have not been changed in the Revised Scheme design.

Figure 4-9 Ground flood FFL Plan – The Site – east of Ship Lane



Drawing by Gillespies, Ref P10736-00-003-GIL-0105, dated 13th September 2019

Figure 4-10 Ground flood FFL Plan: Building B04 – The Maltings

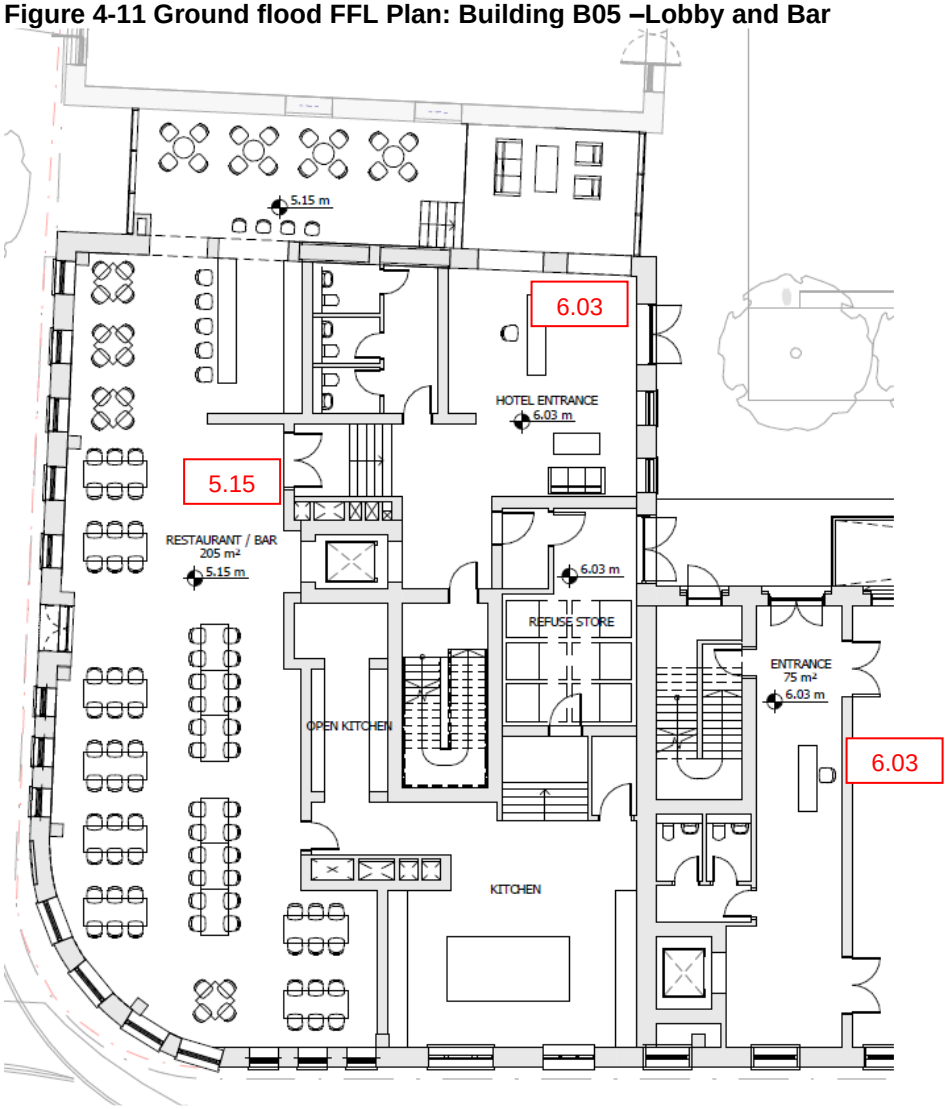


Drawing by Squire & Partners, Ref C645_B04_P_00_001, Rev C, dated 6th April 2020
Arrows show exits from the building, annotations show levels in mAOD

Building B05 (lobby and restaurant/bar)

The ground floor restaurant/bar are at a level of 5.15 mAOD, slightly below the reference flood level for this location of 5.52 mAOD (i.e. the same level as for Buildings B01 and B06 described above). This very small risk has been accommodated within the proposed design. Furthermore, access is available via a small number of steps to the Lobby to a raised area at 6.03 mAOD, which in turn has external access to the ground at the same level.

Figure 4-11 Ground flood FFL Plan: Building B05 –Lobby and Bar

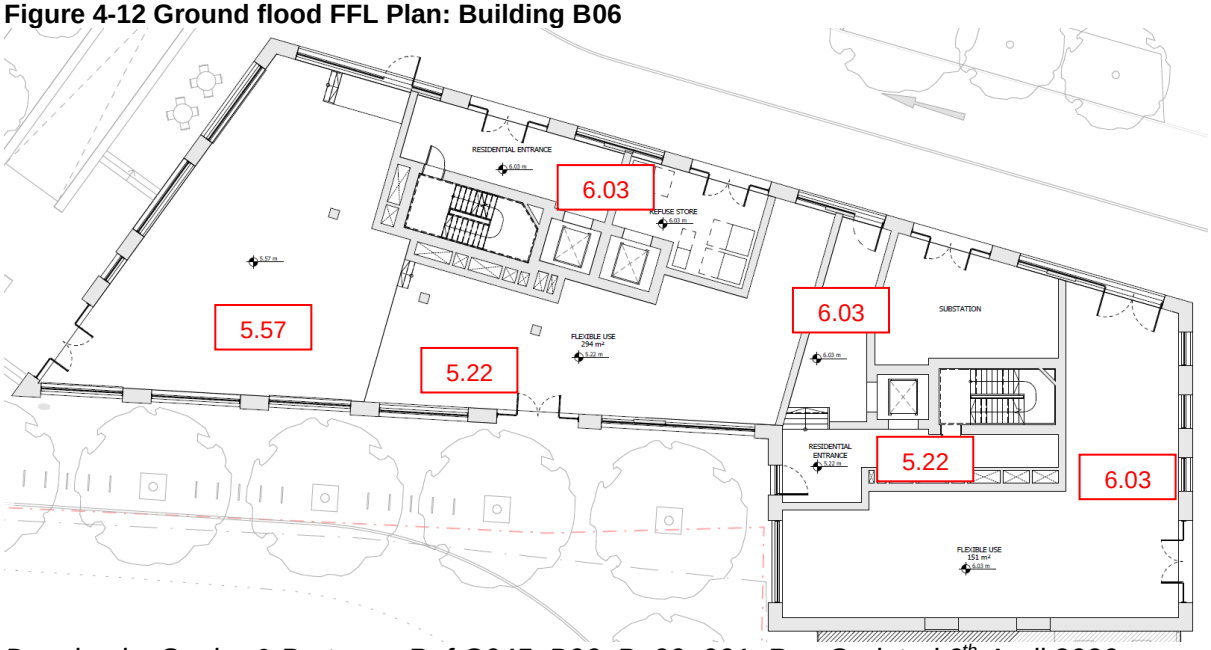


Drawing by Squire & Partners, Ref C645_B05_P_00_001 Rev C dated 6th April 2020
Annotation shows levels in mAOD

Building B06 (Flexible use)

Building 6 features some flexible use space with FFL at 5.22 mAOD as shown in Figure 4-12. This is lower than the reference flood level for this location of 5.52 mAOD. The low risk of residual flooding has been addressed in the design. There is access via steps to higher levels within each of the ground floor units via small number of steps.

Figure 4-12 Ground flood FFL Plan: Building B06



Drawing by Squire & Partners, Ref C645_B06_P_00_001, Rev C, dated 6th April 2020
Annotation shows levels in mAOD

Building B09 (Boathouse)

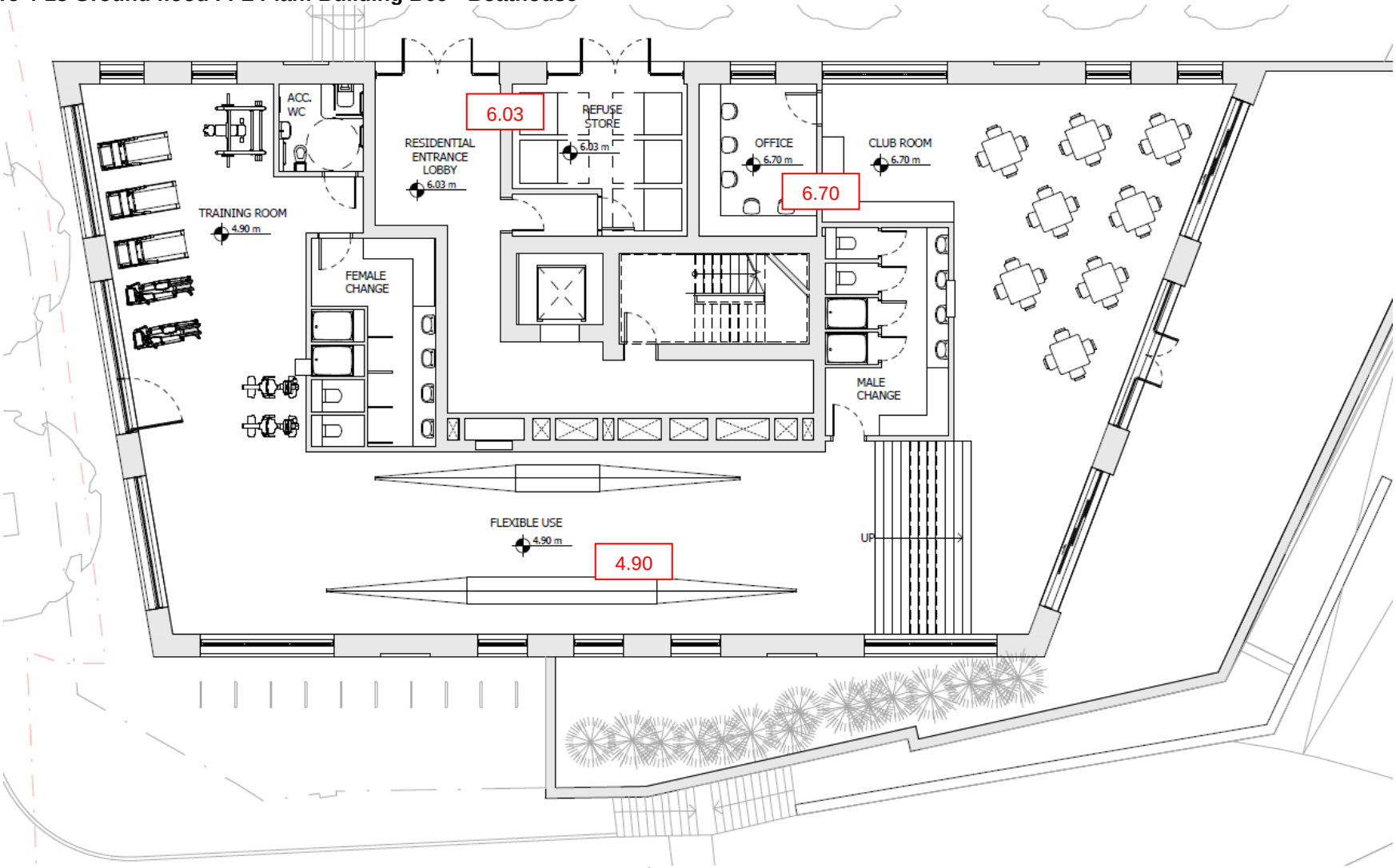
The Boathouse is located at the eastern end of the Site, adjacent to Bull's Alley. This configuration follows discussions held with Environment Agency officials in 2018 and 2019. At the meeting with the Environment Agency on the 3rd December 2018, they reiterated their desire to avoid active defences and that permanent passive defences should be incorporated. The requirement for the River Thames to be easily accessible to users of the Boat House dictates that the Boat House be accessible from the River Thames. Previous options for this building included a defence line within the building. Since the Environment Agency were unhappy with this option, the building has been re-designed to use the external walls of the building instead as a means of flood defence. This will ensure that inspections of the defences can be made easily from public areas, whilst at the same time providing access from the Boat House to the river.

The majority of the ground floor is at 4.90 mAOD (Figure 4-13) in order to provide a facility for boat storage and access to the River. Some Club house facilities will also be provided at this level. However, a raised area, designated as the Club Room (at 6.70 mAOD), will maintain the tidal defensive line as shown in Figure 4-14. The north elevation of the Boathouse is shown in Figure 4-15

The revised proposals also have the benefit of ensuring disabled access from Mortlake High Street, which was raised at the meeting with the Environment Agency, and also allowing users of the Boat House to be able to view the River Thames from inside on the raised section (previously they would have been at a lower level with a large wall/gate obscuring the view of the Thames).

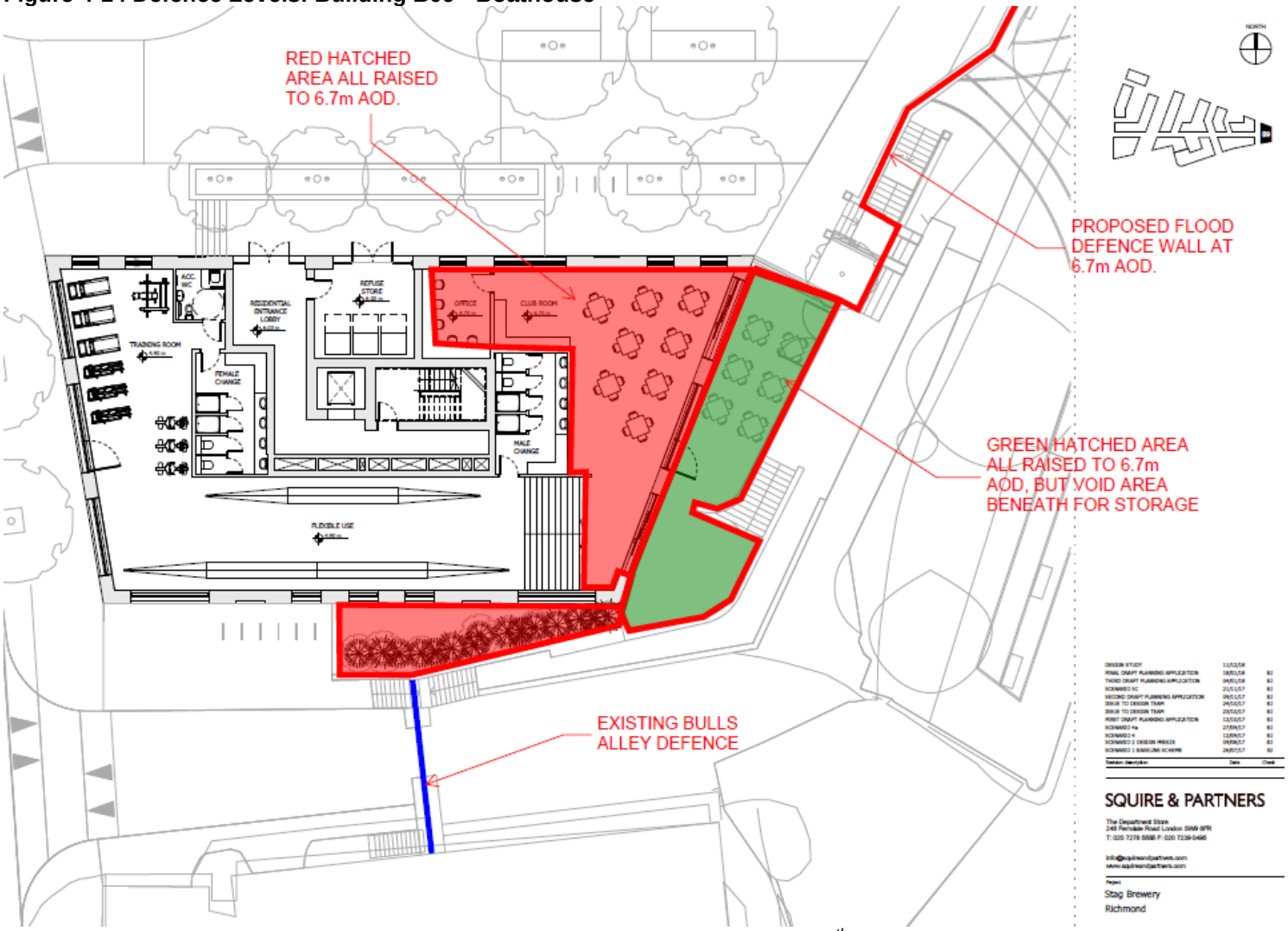
In relation to the Bull's Alley defence, it was agreed with the Environment Agency that no works would need to be undertaken currently to it. However, the proposed development would need to ensure options for raising the Bulls Alley defence would not be limited as a result of the proposals. In order to ensure this, the design does not provide any access routes that front onto Bulls Alley. As a result, a ramp, wall or gate could be installed in the future without affecting the proposed Boat House.

Figure 4-13 Ground flood FFL Plan: Building B09 - Boathouse



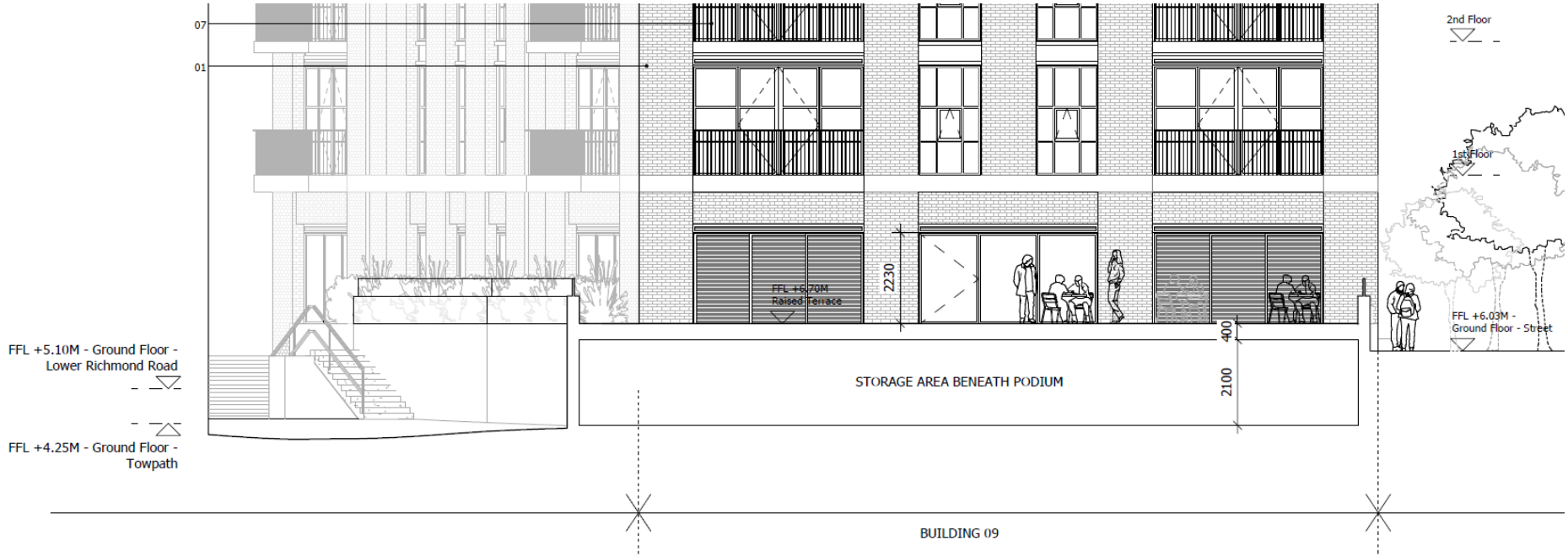
Drawing by Squire & Partners, Ref C645_B09_P_00_001, dated 6th April 2020.
Annotation shows levels in mAOD;

Figure 4-14 Defence Levels: Building B09 - Boathouse



Drawing by Squire & Partners, Ref G200_B09_P_00_002, Rev L dated 11th December 2018.

Figure 4-15 Building B09 – Boathouse – North Elevation



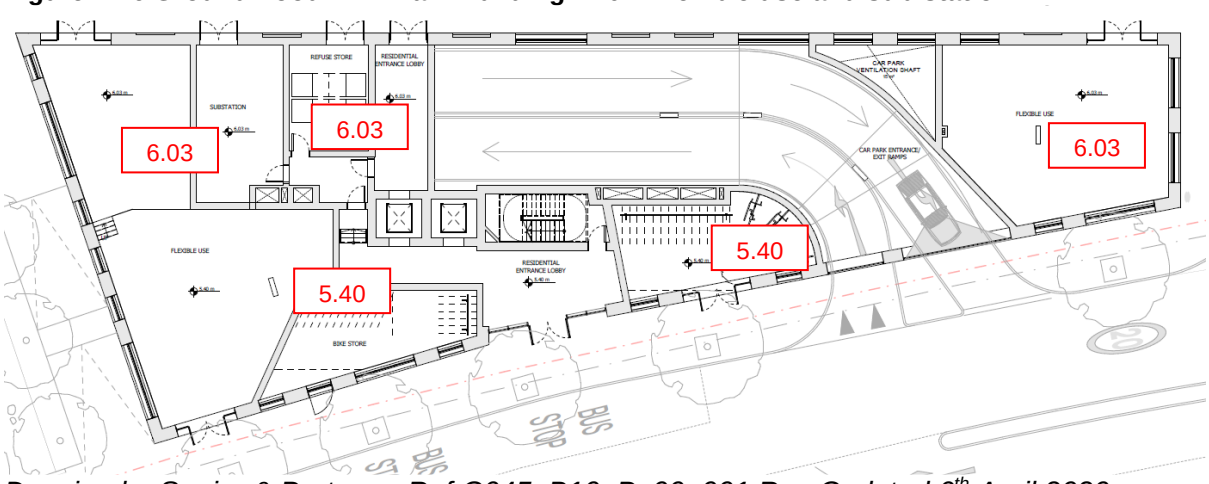
Drawing by Squire & Partners, Ref G200_B09_E_N_001, Rev F dated 11th December 2018.

Building B10 (Flexible use & substation)

Building 10 features some flexible use space along the southern elevation with FFL at 5.40 mAOD. This is lower than the reference flood level for this location. The low risk of residual flooding has been addressed in the design. There is access via steps to levels at 6.03 mAOD at the rear of the unit.

This building also features the sub-station, whose FFL is also at 5.40 mAOD, a facility that will need to be protected from residual risk of flooding. There will be a single point of access to the facility via a secure, flood proof door. A suitable design is available from Flood Control International (http://www.floodcontrolinternational.com/index.php) and shown in Figure 4-17.

Figure 4-16 Ground flood FFL Plan: Building B10 – Flexible use and sub-station

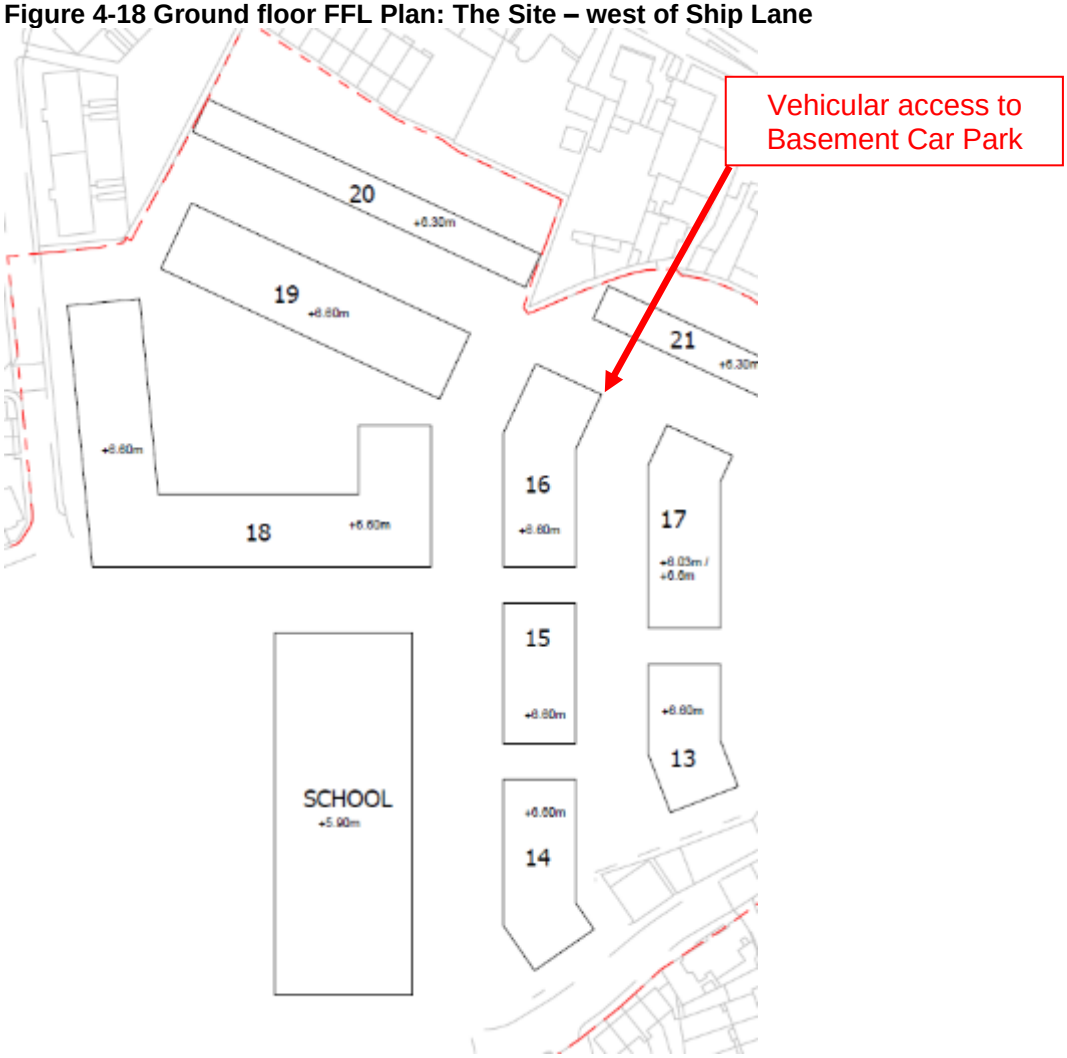


Drawing by Squire & Partners, Ref C645_B10_P_00_001 Rev C, dated 6th April 2020
Annotation shows levels in mAOD

Figure 4-17 Examples of flood proof doors, suitable for sub-station facility

http://www.floodcontrolinternational.com/PRODUCTS/FLOOD-DOORS/secure-flood-doors.html

Figure 4-18 Ground floor FFL Plan: The Site – west of Ship Lane



Drawing by Squire & Partners, Proposed Building Levels- Ground Floor

4.2.4 Basement Car Parks

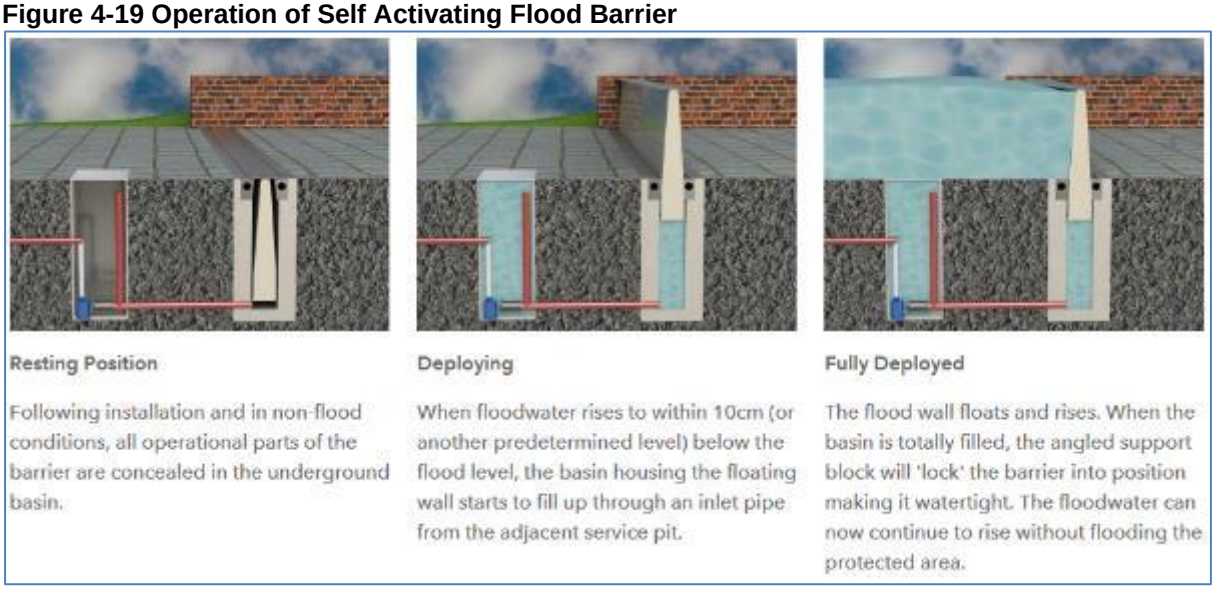
There are basement car parks under the buildings in the Site. The two vehicular entrances to the car park for the section **east** of Ship Lane are shown in Figure 4-9; these are from Ship Lane and from Mortlake High Street. The entrance from Ship Lane is at an elevation of around 6.1 mAOD. This is above the reference flood level for 2100 and no additional protection is required.

The entrance from Mortlake High Street is at an elevation of around 5.3 mAOD and is below the reference flood level. There is accordingly a small residual risk from any breach in the vicinity of Bull's Alley. It is proposed to install a self-activating flood barrier (SAFB) across this entrance. This is a passive system that is activated by water levels in a float chamber.

The vehicular entrance to the site (immediately to the east of the entrance to the basement car park) will be permanently manned, with the duty official located in Building B09 (Boathouse). They would be alerted to rising water levels in the float chamber via a warning system. The warning system would alert drivers to the imminent deployment of the SAFB.

Whilst the primary purpose of the SAFB would be to mitigate the residual risk due to breach, it would also be effective in preventing surface water runoff on Mortlake High Street from entering the basement car park.

Figure 4-19 Operation of Self Activating Flood Barrier



https://www.m3floodtec.com/self-activating-flood-barrier (accessed on 27 August 2019)

The entrance to the car park for the Site **west** of Ship Lane is shown in Figure 4-18. It is within the site and is at an elevation of 6.3 mAOD, which is above the reference flood level.

The basement car park will be equipped with a drainage system for removal of any rainfall on the ramps along with that brought into the basement on vehicles.

4.2.5 Access/Egress arrangements

It is a fundamental requirement of the NPPF that any developments in flood risk areas should provide "safe" and preferably "dry" pedestrian access/egress during reference flood conditions. The reference flood in this case would be the TE2100 design water levels, for which no specific probability is assigned.

Whilst the proposed development is located in a tidal flood zone, the land raising and setting of finished floor levels within the site mean that the entire site is at a safe level. This means that even in the event of overtopping of defences or a breach, the TE2100 levels would not encroach on the residential accommodation, all of which is set at a minimum of 7.03 mAOD, well above the reference flood level. The principal streets have been set at a minimum level of 6.03 mAOD in the Site east of Ship Lane (Figure 4-9) and 6.30 mAOD in the section west of Ship Lane Figure 4-18). Given this level of protection, residents should have no need for emergency egress from the site due to flood conditions. Indeed, it may well be the case that the elevated nature of the site provides a safe refuge for residents of low-lying neighbouring properties that would be at a greater risk from flooding.

However, in line with the pre-application response from LBRuT, a Flood Emergency Plan (FEP) has been prepared (Appendix G). The Plan identifies a safe route from the site to land that is wholly outside Flood Zone 3.

4.2.6 Groundwater flooding

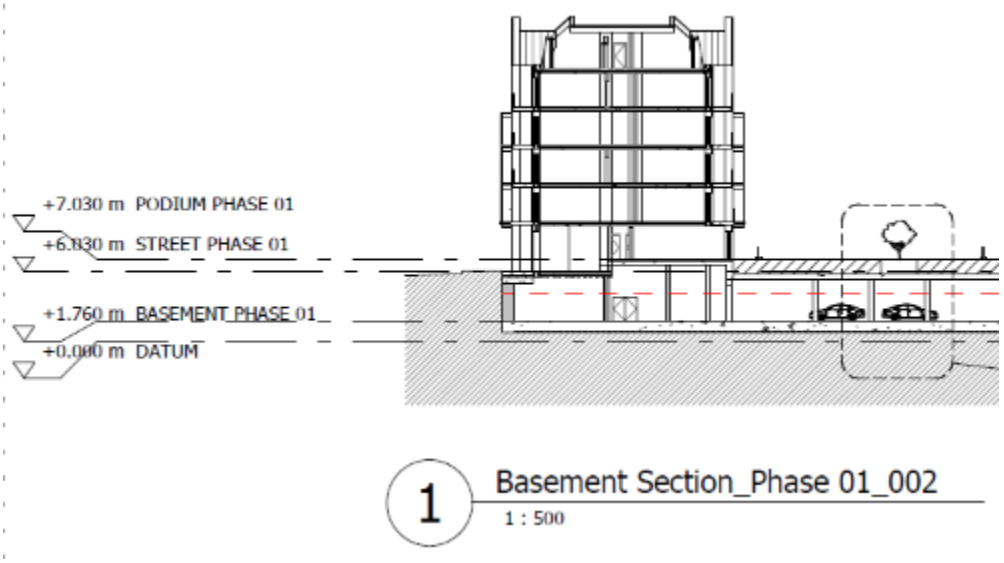
It was noted in Section 3.3.2 that groundwater levels varied across the site from around 1.7 mAOD in the centre of the site (around Ship Lane) to around 1.35 mAOD on the western edge of the site. Levels for the eastern part of the site were difficult to obtain due to the nature of the ground. Occasional perched levels were also observed at different locations across the site as highlighted in Section 3.3.2.

As described in Section 4.1, the proposed development will incorporate a basement car park. The proposed level of the base of the slab under the car park is shown in Figure 4-20 and Figure 4-22 for the Site east and west of Ship Lane respectively. The nominal slab thickness is 1.0 m, though lower thicknesses may be viable in detailed design.

For the Site east of Ship Lane, the underside of the slab is shown as 0.76 mAOD. This is around 1.25 m below the typical groundwater level of 2 mAOD. Whilst locally, some higher levels have been observed up to 3 mAOD, these are believed to be perched water tables that reflect local interventions. Whilst this encroachment does not pose any groundwater flood risk, either on-site or off-site, they will need to be taken account of in design and construction of the basement. Preliminary estimates of groundwater flows associated with high transmissivity gravels (MacDonald et al., 1999) and the naturally occurring groundwaters of the underlying minor aquifer range from 0.1 to 0.5 m^3/s under wet weather conditions. In the September 2019 revised design, basement levels under Building B01 (cinema) are locally lower at -1.635 mAOD (Figure 4-21). This is to accommodate Plant Rooms and a Tank Room in Basement Level 2 with cinemas in Basement Level 1.

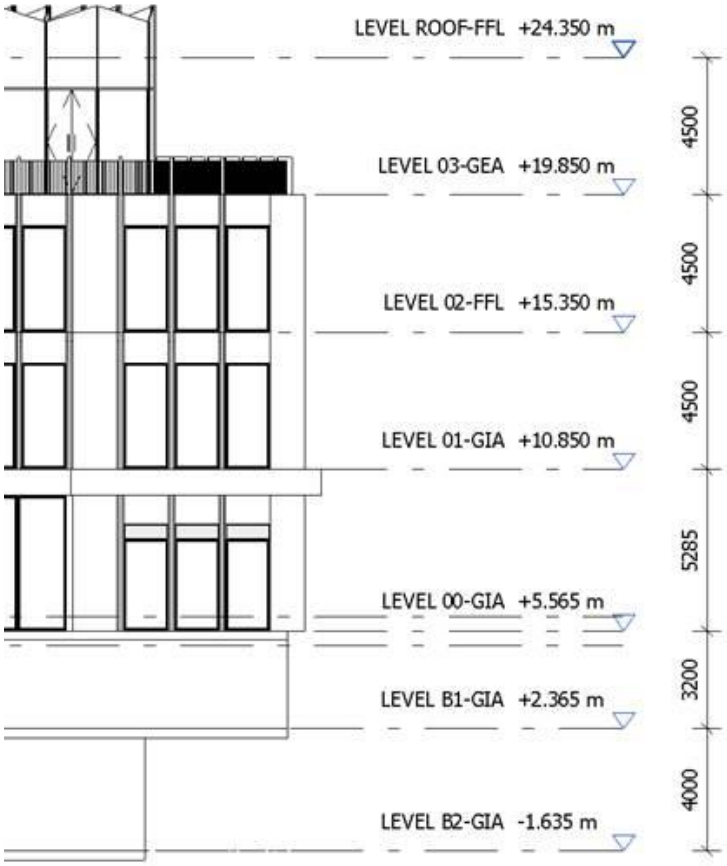
Therefore, permanent control of groundwater flows by drainage methods and temporary control of groundwater seepage during excavations (foundation dewatering) should be features of the design mitigation measures for the proposed basement car park and Cinema.

Figure 4-20 Proposed Basement levels: East of Ship Lane



Drawing by Squire, Reference G100_P1_S_002 (indicative drawing)

Figure 4-21 Proposed Basement levels: Building B01 (Cinema)

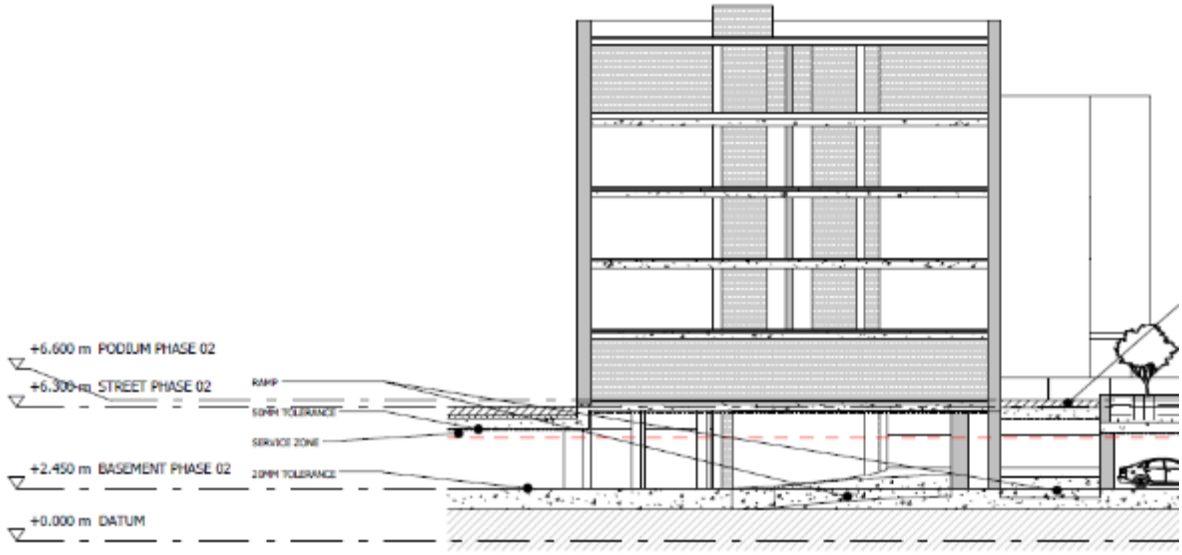


For the section west of Ship Lane, the underside of the slab varies from around 1.45 mAOD to 3.1 mAOD under buildings as shown. All proposed buildings in the Site west of Ship Lane will be above the observed groundwater levels of September 2015 and no mitigation will be required.

There are no changes to the basement levels in the September 2019 revised design west of Ship Lane.

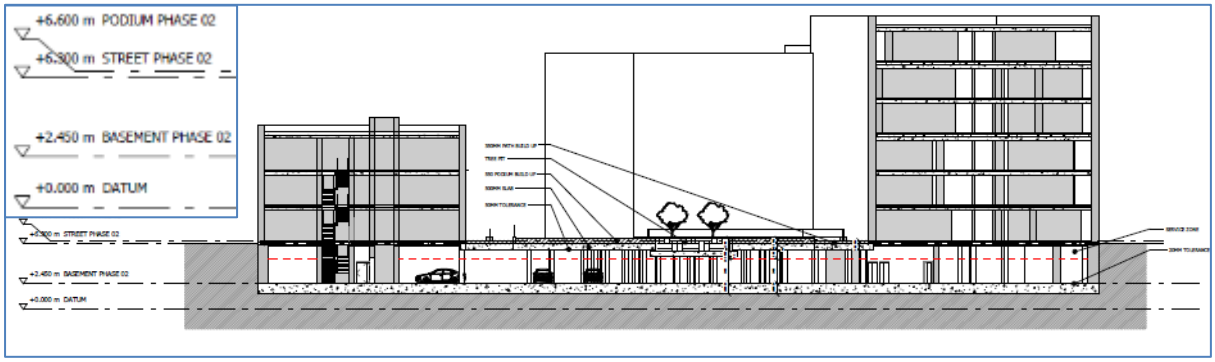
Figure 4-22 Proposed Basement levels: West of Ship Lane

a) Section 01 (Buildings 16 & 17)



Drawing by Squire, Reference G100_P2_S_001 (indicative drawing)

b) Section 02 (Buildings 18 & 19)



Drawing by Squire, Reference G100_P2_S_002 (indicative drawing)

4.3 Off Site Impacts

4.3.1 General

It is a fundamental principle of the NPPF that there should be no adverse impact of any development on others. This Section reviews the possible impacts of the development on adjacent properties and offers mitigation where this is required.

4.3.2 Flood Plain storage

The Environment Agency was consulted in 2016 as to whether any flood storage compensation would be required for this proposed development. The response is provided in Appendix C.1 and which states that *"We can confirm that as the site is only at risk of tidal flooding flood storage compensation will not be required."*

4.3.3 Drainage Strategy

The Drainage Strategy has been undertaken by Waterman IE. This is described in a report (Reference *WIE15582-106-R-2-5-3-DS*) that will be submitted under separate cover. A summary of the Drainage Strategy is provided in this Section.

This Drainage Strategy has been produced to cover the Site (Applications A and B). Drainage associated with highways and surface water runoff from the highway drainage associated with the S278 Chalkers Corner works will be addressed as part of the wider highways drainage and would be discharged to the sewer as existing, will not be attenuated, and would continue to be managed by the local highways authority. It is therefore considered to be appropriate and robust to focus the Drainage Strategy on the Stag Brewery part of the Site herein.

Surface water runoff from the northeast of the Application A site would discharge by gravity to the River Thames (adjacent to the northern boundary of the Site) via three outfalls. As the River Thames is tidal in this location, direct discharge to the river would be unrestricted. The area to discharge into the River Thames has been maximised using shallow geocellular conveyance channels, in order to relieve the Thames Water network of flows. Surface water runoff from the remainder of the Site would discharge via gravity to the Thames Water sewer network in the surrounding highways, maximising the attenuation volume within each drainage catchment to restrict surface water flows as much as possible.

Based on an area of 5.89 ha currently draining into the Thames Water network, the existing discharge rate was calculated to be 841 l/s. The incorporation of permeable paving, rain gardens, and underground attenuation tanks achieves a reduction of surface water flows to 249 l/s, equal to a 70% reduction compared to the existing rate. This approach has been agreed with the Greater London Authority.

Appropriate treatment would be incorporated into the drainage system to ensure that the quality of water discharged is acceptable. This would be achieved through the incorporation of green roofs, permeable paving aggregate sub-base, rain gardens, and rainwater harvesting. A biomat filtration system within the attenuation tanks and downstream defenders or similar hard engineered solution would also be incorporated if deemed necessary at detailed design to ensure discharge is appropriately treated.

Thames Water have previously confirmed that there is capacity for the proposed surface flows, though the scheme has since changed with the proposed flow rates now lower than previously agreed. Thames Water have been contacted to confirm that there is capacity for the amended proposed flows, with a response currently outstanding.

The on-Site drainage networks and Sustainable Drainage Systems would be privately managed and maintained for the lifetime of the Development (Applications A and B), ensuring they remain fit for purpose and function appropriately. The management company / operator would be appointed post-planning. The school drainage system (Application B) would be delivered and maintained separately from the Application A and C sites.

The Drainage Strategy Report confirms that surface water runoff from the Site (Applications A and B) can be managed sustainably to ensure that flood risk is not increased elsewhere. It is considered that the information provided within this report satisfies the requirements of the National Planning Policy Framework (NPPF) and the London Plan.

4.3.4 Breach of Tidal Defences

The breach modelling that has been undertaken by the Environment Agency is described in Section 3.5. Further modelling has been undertaken as part of this FRA to establish the impact

that the proposed development may have on flood extents resulting from breach analysis. The work is described in Appendix D and the main findings are as follows:

i. The risk of breach would be substantially reduced following the proposed development due to the significant upgrading of defences along the river frontage.
ii. Following the completion of the development, the breach as modelled by the Environment Agency (with an arbitrary breach width of 20 m), could not occur due to the land raising behind the defences. The most likely location for a breach would therefore be at the stop-logs in Bull's Alley. At this point, the maximum width of breach is reduced to 6 m.
iii. The risk of a breach at this location is considered very small since the location is routinely inspected.
iv. Model runs have been undertaken to compare the flood extents resulting from a breach at Bull's Alley with those from Environment Agency modelling. These show a general reduction in flood levels and extents throughout the affected area. Whilst there are some localised increases, these reflect the finer model grid used to model the breach at Bull's Alley for the developed case. They are, accordingly, not a cause for concern.

In summary, the proposed development is considered to result in a significant reduction in residual risk. This is partly due to the greater integrity of the defences, post development, and partly due to likely lower incidence of breach at the stop-logs in Bull's Alley. The modelling undertaken as part of this FRA has shown a general reduction in flood extent and depths compared with the Environment Agency modelling.

Subsequent to the modelling described in Appendix D being undertaken, the Environment Agency has updated its own modelling, the impacts of which have been discussed in Section 3.5. It should be noted that the modelling undertaken for this FRA was "relative modelling" i.e. to only compare the results of different breach scenarios. Accordingly, there seemed little benefit in repeating this substantial modelling exercise with the more recent Environment Agency model.

4.3.5 Groundwater flooding

It was noted in Section 4.2.6 that the proposed basement car park would project into the saturated area under the Site east of Ship Lane, but that the basement under the section west of Ship Lane would be above typical groundwater levels. It is important that any such projection does not lead to adverse impacts on third parties. In reviewing possible impacts, it was observed that the groundwater flow paths were to the west and south-west and away from the River Thames. It was inferred that the levels in the Thames, averaged over a tidal cycle of around 2 mAOD, were providing the "source" for the associated hydraulic gradient. Any projection of the basement into this saturated area would not lead to any increase in groundwater levels off site. A small reduction on the southern side of the development is the most likely response and this would not require any mitigation.

4.4 Residual Risks

The principal residual risks for this site are associated with design exceedance, breach of the defences and maintenance of the drainage infrastructure.

In relation to design exceedance, full reference has been made in this FRA to the extreme water levels for 2100 provided by the Environment Agency. This provides appreciable contingency in the early years of the development. This also applies to the drainage strategy which has been based on the incrementing rainfalls by 40%. Even for the design conditions, it is considered that the site is well buffered against design exceedance. The FFL for

residential property is at a minimum of 7.03 mAOD, which is 1 m above the reference flood level for 2100. This provision is also helpful in relation to design exceedance of the SuDS, since there will be appreciable storage at the ground surface.

The implications of breach have been modelled as part of this FRA with the results shown in Appendix D . The landscaping of the site means that it is well protected from the impacts of any breach. Furthermore, the model results presented in Appendix D show that the peak levels for a breach following the development of the site would be lower than those predicted by Environment Agency modelling.

In relation to maintenance, the key issues requiring routine maintenance will be the components of the SuDS and flood resilience measures. The maintenance of the SUDS will be the responsibility of the management company/operator. It is likely that the routine inspection and maintenance would be contracted out and that the contractor may well provide an emergency service on a call-out basis. The flood resilience measures will comprise the SAFB at the entrance to the basement car park from Mortlake High Street (Section 4.2.4), plus flood proof doors on Building B09 - Boathouse (Section 4.2.3)

4.5 Risks During Construction

The construction activities will involve demolition of existing buildings (excluding The Maltings), construction of new buildings and associated landscaping. These will involve storage of waste materials, prior to being transferred off-site and storage of building materials and plant. Construction activity may lead to wash off of silt and pollutants to the surface drainage system. Measures for interception should be put in place to minimise this risk.

The potential for impacts to occur as a result of storage of materials will be minimised by the following measures:

- Storage compounds (for the storage of construction materials or temporary stockpiling of material from demolished buildings) will be located away from the Thames and drains;
- Drums and barrels will be stored in a designated bunded safe area within a site compound; and
- All drums and barrels will be fitted with flow control taps and will be properly labelled.

The Construction Site Manager should also be in receipt of flood warnings for the Thames from the Environment Agency.

The construction of the basement will involve excavation to below likely groundwater levels. Provision will therefore be needed for dewatering and disposal. This may require an Environmental Permit from the Environment Agency.

The proposed development will also involve improvements of the existing defences. All such work would be undertaken in conjunction with the Environment Agency to ensure necessary approvals for design and constructional sequence through Environmental Permits (formerly Flood Defence Consents). In particular, it will be necessary to ensure the integrity of the existing tidal defences throughout the period of construction. This will be achieved by the use of temporary defences to provide the required level of protection until any replacements are in place and only demolishing the existing river wall once the new river wall has been built. Should there be any requirement for tying in new defences to existing alignments, this will be undertaken at times when there is no practical risk of tidal flooding.

4.6 Climate Change

NPPF requires a consideration of the impacts of climate change on the flood risk for any proposed development. A summary of the current guidelines is provided in Appendix F .

The Environment Agency has provided peak flood levels for the River Thames up to 2100 and taking account both of climate change (through its impact mainly on sea levels) and the likely operating and maintenance strategy for the Thames Barrier. As indicated above, the drainage strategy has used rainfall estimates, incremented by 40% to account for climate change over the lifetime of the scheme.

5. Summary

This Report presents an FRA for the proposed development of the Stag Brewery in Mortlake, adjacent to the River Thames.

It has been informed by discussions with the LBRuT, The Environment Agency and Thames Water, with officials from each organisation providing valuable input, relevant data and feedback. The main findings are as follows, with cross referencing to the appropriate Section of the FRA shown in square brackets. It has been updated to reflect the changes forming part of the "Revised Scheme" undertaken in 2020.

1. The proposed development is for a mixed development featuring residential, retail and leisure use, along with a secondary school. It is located in **flood zones 2 and 3** but behind the tidal defences [Section 3.5]. Residential use has a vulnerability classification of "More Vulnerable". It is only acceptable in flood zone 3 if both the Sequential Test and the Exception Test have been satisfied.

2. The Stag Brewery site has been commented on in the LBRuT council's Flood Risk **Sequential Test** (2016a) which states that: "This is a site for major redevelopment and regeneration as the brewery has closed, and as such, it is not appropriate / possible to accommodate the proposed uses on an alternative site in the borough at lower probability of flooding. Subject to review by the Environment Agency, the Sequential Test is deemed to have been satisfied. [Section 2.3]

3. **The Exception Test** involves two components based on the sustainability credentials of the development and an acceptable FRA. Subject to this FRA being acceptable, the Exception Test is deemed to have been passed, based on pre-application advice from LBRuT which states: "…the Council can confirm that development of this site in line with the draft Local Plan proposal site (SA23), as supported by the Flood Risk Sequential Test, will provide wider sustainability benefits because it is now a derelict site" [Section 2.3].

4. **Flood levels** at the site result from a complex interaction of predominantly tidal factors and the operation of the Thames Barrier. The Environment Agency has provided the results of detailed hydraulic modelling from the TE2100 Study. The reference flood level for the site is 6.03 mAOD for 2100 [Section 3.3 and 3.5].

5. **Other sources of flooding** have been reviewed in the FRA. The risks to the site from fluvial flooding, surface water flooding and reservoir failure are considered small. However, and as guided by the LBRuT pre-application response, the risk to the site and surrounding area from groundwater flooding has been reviewed. Hydraulic gradients fall in a westerly and south-westerly direction, confirming that the River Thames acts as a boundary. It is only in the lower, eastern part of the site where groundwater was encountered close to the surface. These elevated levels are likely to reflect the historical development of the site. [Section 3.3]

6. The site currently benefits from **tidal flood defences** along the river frontage. These are formed from the residual walls from historic buildings plus The Maltings, a building which is being retained. As part of the development, the tidal defences will be remodelled. The crest will be at, or above, the Environment Agency's recommended 2100 crest level of 6.70 mAOD, so there will be no need to increase the defences over this timescale. The risk of breach of the new defences is considered negligible, due to the landscaping of the site and backfilling on the landward side of the defences. A more open river frontage will be created in line with the aspirations of the Environment

Agency. A small section of the tidal defences that are currently formed by Ship Lane will need to be raised in the future with the current proposal based on the raising of Ship Lane to create a passive defence. [Section 4.2.2].

7. **Finished floor levels for the residential development** is at a minimum level of 7.03 mAOD throughout the Site. [Section 4.2.3].

8. **Finished floor levels for non-residential use** is predominantly at a level of 6.03 mAOD i.e. the reference flood level for 2100. However, the FFL for some buildings is below the reference flood level. These have been reviewed individually to ensure that the residual risk is appreciated in the design and to ensure that there is safe access to higher levels. [Section 4.2.3].

9. **The Basement** is not for habitation but is solely for car parking with separate car parks under the parts of the Site, east and west of Ship Lane. There are two entry/exit ramps for the car park to the east of Ship Lane; that in Ship Lane will be located above the reference flood level, whilst that in Mortlake High Street will be protected by a self-activating flood barrier. [Section 4.2.4]. The single entry/exit for the car park to the west of Ship Lane will be above the reference flood level.

10. It has been confirmed by the Environment Agency that, since the area is affected by tidal flooding, there is no requirement to provide **Flood Storage Compensation.** [Section C.1 and Section 4.3.2]

11. The **surface water drainage strategy** has been prepared under separate cover by Waterman IE. Part of the site would discharge on an unrestricted basis to the River Thames. The remainder would discharge to the Thames Water sewer, via attenuation storage that would lead to a 70% reduction below the existing rate of runoff. This satisfies the requirements of the NPPF and the London Plan. [Section 4.3.3]

12. The proposed development is considered to have no significant influence on groundwater levels in the surrounding area. This follows from the hydraulic gradient being away from the River Thames [Section 4.3.5].

13. **Safe access** and egress is provided within the site, where access is available to all residential property with at, or above the reference flood level for 2100 [Section 4.2.5 and Appendix G]

14. A **Flood Emergency Plan** has been prepared in line with the LBRuT requirements and is included as Appendix G . However, this is a precautionary plan, since it is not envisaged that there would be any requirement to evacuate the site.

15. Under the conditions envisaged by the Flood Emergency Plan, the development would provide **benefits to the wider community** including the provision of emergency car parking; use of the proposed emergency access and use of the site as a refuge [Appendix F]

16. The **Residual Risks** are mainly due to the risk of breach of the tidal defences. This risk is negligible for current flood levels but will increase in line with projected increases in tidal flood levels. **Breach modelling** has been undertaken (Appendix D and Section 4.3.4). This has shown that there is a general reduction in flood extents and depths resulting from a breach following the development of the Site. Other risks have been assessed and are considered to be negligible. [Section 4.4] A maintenance programme of key drainage infrastructure should be put in place by Site Managers to ensure that residual risks are minimised.

17. Flood risks during the **period of construction** have been assessed and, with the adoption of standard site management practice, they should be of no practical consequence. It is anticipated that the construction of the basement will require dewatering of the excavation area. [Section 4.5]

18. A **statement of flood risk** should be provided to all residents that they can provide to their Insurance Company (or other organisations).

19. In summary, the proposed development will provide residential accommodation plus related activity at a safe level. The drainage strategy has demonstrated that this will lead to a reduction in peak rates of runoff from the site. The provision of elevated living accommodation with a range of access/egress routes will provide benefits to the local residents under flood conditions, as well as a refuge in times of extreme flooding. The proposed development is considered to be in accordance with the NPPF, LBRuT guidelines and the London Plan.

20. The Planning Committee Report for the 29th January 2020 meeting acknowledged that the Application satisfied the requirements of the Environment Agency, the LBRuT, the Lead Local Flood Authority and the London Plan in respect of flood risk and drainage. The scheme changes since then, which are described in this version 4 of the FRA, do not alter this conclusion.

6. References

Author	Date	Title/Description
AECOM	July 2015a	Stag Brewery: Phase 1 Environmental Site Assessment. For AB InBev UK Ltd
AECOM	Sept 2015b	Stag Brewery: Phase 2 Environmental Site Assessment. For AB InBev UK Ltd
AECOM	February 2016	Stag Brewery: Groundwater Sampling Point Decommissioning Report. For AB InBev UK Ltd
Centre for Ecology and Hydrology.	2009	The Flood Estimation Handbook CD-ROM 3. Centre for Ecology & Hydrology, Wallingford, Oxon, UK.
CIRIA	2015	The SUDS Manual - CIRIA Report C753.
DCLG	Mar 2012a	National Planning Policy Framework.
DCLG	Mar 2012b	Technical Guidance to the National Planning Policy Framework.
DEFRA / Environment Agency	May 2008	Supplementary note on flood hazard ratings and thresholds for development planning and control purpose – Clarification of the Table 13.1 of FD2320/TR2 and Figure 3.2 of FD2321/TR1. Surendran et al.
DEFRA / Environment Agency	2013	Rainfall Runoff Management for Development Report SC030219
Environment Agency	Nov 2012	Thames Estuary 2100: Managing flood risk through London and the Thames estuary.
Greater London Authority	2016	The London Plan: The Spatial Development Strategy for London.
Institute of Hydrology	1999	Flood Estimation Handbook,
London Borough of Richmond upon Thames Council	2009	Local Development Framework Core Strategy. Available from: http://www.richmond.gov.uk/core_strategy-3.pdf [Accessed: 19/10/2016].
London Borough of Richmond upon Thames Council	2011	Local Development Management Plan. Available from: http://www.richmond.gov.uk/final_development_management_plan_adopted_nov_2011.pdf [Accessed: 19/10/2016].
London Borough of	2016a	Flood Risk Sequential Test. Available from:

Richmond upon Thames Council		http://www.richmond.gov.uk/local_plan_flood_risk_sequential_test_report.pdf [Accessed:19/10/2016].
London Borough of Richmond upon Thames Council	2018	Local Plan – 6.2 Flood Risk and Sustainable Drainage. Available from: https://www.richmond.gov.uk/media/15935/adopted_local_plan_interim.pdf [Accessed: 19/05/2020].
London Borough of Richmond upon Thames Council	2016c	Strategic Flood Risk Assessment Update. Available from: http://www.richmond.gov.uk/flood_risk_assessment [Accessed: 19/10/2016].
Marshall D.C.W. & Bayliss A.C	1994	Flood estimation for small catchments, IH Report No. 124, Institute of Hydrology, Wallingford and Hall, Hockin & Ellis
Mayor of London	2019	The London Plan. Spatial Development Strategy for Greater London.
Ministry of Housing, Communities and Local Government	February 2019	National Planning Policy Framework.
Port of London Authority	2016	Tide Tables and Port Information. Available from: https://pla.co.uk/assets/platidetablesmaster2016lr.pdf [Accessed: 24/10/2016]
Waterman IE	2016a	Condition Survey of the Thames River Wall, Stag Brewery, Mortlake, London. 2016. Report WIE10667-102-R-1-1-1-CS.
Waterman IE	2016b	Environmental Risk Assessment: Stag Brewery East Site, Mortlake, London. November 2016.
Waterman IE	2017	Maltings Building- Wall Assessment: Stag Brewery. Report WIE10667-102-R-2-1-3.
Waterman IE	2020	The Former Stag Brewery, Mortlake - Drainage Strategy –Revised Scheme WIE15582-106-R-2-5-3-DS.

Appendix A Flood Risk Assessment Template (Based on NPPF Practice Guide)[1]

This proforma has been completed in such a way as to identify the sections in the accompanying report where the relevant issues are addressed.

1 Development description and location
1a. What type of development is proposed and where will it be located? • A location plan at an appropriate scale should be provided with the FRA, or cross referenced to the main application when it is submitted.
Section 2.1
1b. What is its vulnerability classification? • Vulnerability classifications are provided in Table 2, NPPF Technical Guide
Section 2.1
1c. Is the proposed development consistent with the Local Development Documents?
1d. Please provide evidence that the Sequential Test or Exception Test has been applied in the selection of this site for this development type? • Evidence is required that the Sequential Test has been used in allocating the proposed land use proposed for the site and that reference has been made to the relevant Strategic Flood Risk Assessment (SFRA) in selecting development type and design (See paragraphs 100-104, NPPF and paragraphs 3-5, NPPF Technical Guide). Your Local Planning Authority planning officer should be able to provide site-specific guidance on this issue. • Where use of the Exception Test is required, evidence should be provided that all three elements of this test have been passed (see paragraphs 102, NPPF and paragraphs 4-5, NPPF Technical Guide). Your Local Planning Authority planning officer should be able to provide site-specific guidance on this issue.
Section 2.3
1e. *[Particularly relevant to minor developments (alterations & extensions) & changes of use]* Will your proposal increase overall the number of occupants and/or users of the building/land; or the nature or times of occupation or use, such that it may affect the degree of flood risk to these people?
2. Definition of the flood hazard
2a. What sources of flooding could affect the site? (see paragraph 2, NPPF Technical Guide). • This may include hazards such as the sea, reservoirs or canals, which are remote from the site itself, but which have the potential to affect flood risk (see Chapter 3 of the Practice Guide).
Section 3.2
2b. For each identified source, describe how flooding would occur, with reference to any historic records wherever these are available. • An appraisal of each identified source, the mechanisms that could lead to a flood occurring and the pathways that flood water would take to, and across, the site. • Inundation plans, and textural commentary, for historic flood events showing any information available on the mechanisms responsible for flooding, the depth to which the site was inundated, the velocity of the flood water, the routes taken by the flood water and the rate at which flooding occurred.
Section 3.3
2c. What are the existing surface water drainage arrangements for the site? • Details of any existing surface water management measures already in place, such as sewers and drains and their capacity.
Section 3.4
3. Probability
3a Which flood zone is the site within? • The flood zones are defined in Table 2, NPPF Technical Guide.

[1] http://planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/

Sections 2.2
3b If there is a Strategic Flood Risk Assessment covering this site, what does it show? • The planning authority can advise on the existence and status of the SFRA.
Section 2.3
3c What is the probability of the site flooding taking account of the contents of the SFRA and of any further site-specific assessment? This may need to include • a description of how any existing flood risk management measures affect the probability of a flood occurring at the site FRA Pro-forma • supporting evidence and calculations for the derivation of flood levels for events with a range of annual probability • inundation plans of, and cross sections through, the existing site showing flood extents and levels associated with events with a range of annual probability • a plan and description of any structures which may influence the probability of a flood occurring at the site. This may include bridges, pipes/ducts crossing a watercourse, culverts, screens, embankments or walls, overgrown or collapsing channels and their likelihood to choke with debris. • details of any modelling studies completed to define the exiting degree of flood risk (Ref Chapter 3 of the PG)
Section 3.5
3d What are the existing rates and volumes of run-off generated by the site? • This should generally be accompanied by calculations of run-off rates and volumes from the existing site for a range of annual probability events (see Section 21 of the NPPF Practice Guide).
Section 4.3
4. Climate change
4a How is flood risk at the site likely to be affected by climate change? • Paragraphs 11-15, of the NPPF Technical Guide provide guidance on how to assess the impacts of climate change.
Section 4.6
5. Detailed development proposals
Where appropriate, are you able to demonstrate how land uses most sensitive to flood damage have been placed in areas within the site that are at least risk of flooding, including providing details of the development layout? • Reference should be made to Table 2 of the NPPF Technical Guide. • Chapter 4 of the Practice Guide provide guidance on how the sequential approach can be used to inform the lay-out of new development sites.
Section 4.1
6. Flood risk management measures
How will the site be protected from flooding, including the potential impacts of climate change, over the development's lifetime? • This should show that the flood risk management hierarchy has been followed and that flood defences are a necessary solution. This should include details of any proposed flood defences, access/egress arrangements, site drainage systems (including what consideration has been given to the use of sustainable drainage systems) and how these will be accessed, inspected, operated and maintained over the lifetime of the development. This may need to include details of any modelling work undertaken in order to derive design flood levels for the development, taking into account the presence of any new infrastructure proposed.
Section 4.2
7. Off site impacts
7a How will you ensure that your proposed development and the measures to protect your site from flooding will not increase flood risk elsewhere? This should be over the lifetime of the development taking climate change into account. The assessment may need to include: • Details of the design basis for any mitigation measures (for example trash screens, compensatory flood storage works and measures to improve flood conveyance). A description of how the design quality of these measures will be assured and of how the access, operation, inspection and maintenance issues will be managed over the lifetime of the development. • Evidence that the mitigation measures will work, generally in the form of a hydrological and hydraulic modelling report.

• An assessment of the potential impact of the development on the river, estuary or sea environment and fluvial/coastal geomorphology. A description of how any impacts will be mitigated and of the likely longer-term sustainability of the proposals.
Section 4.3
7b How will you prevent run-off from the completed development causing an impact elsewhere? • Evidence should be provided that drainage of the site will not result in an increase in the peak rate or in the volumes of run-off generated by the site prior to the development proceeding.
Section 4.3
8. Residual risks
8a What flood-related risks will remain after you have implemented the measures to protect the site from flooding? • Designing for event exceedence on site drainage systems is covered in Section 14 of the NPPF Practice Guide.
Section 4.4
8b How, and by whom, will these risks be managed over the lifetime of the development? • Reference should be made to flood warning and evacuation procedures, where appropriate, and to likely above ground flow routes should sewers or other conveyance systems become blocked or overloaded. This may need to include a description of the potential economic, social and environmental consequences of a flood event occurring which exceeds the design standard of the flood risk management infrastructure proposed and of how the design has sought to minimize these – including an appraisal of health and safety issues.
Section 4.4

Appendix B Scoping Level Flood Risk Assessment

Andrea Kitzberger
London Borough of Richmond upon Thames
Civic Centre
44 York Street
Twickenham
TW1 3BZ

22nd July 2016

Ref: K0685/ah

Dear Andrea

THE STAG BREWERY, MORTLAKE, SW14 7ET
FLOOD RISK ASSESSMENT – LEVEL 1 SCOPING REPORT

Hydro-Logic Services has been asked to prepare the FRA in support of the Planning Application for the above site. Given its profile, we considered it appropriate to submit a Scoping (Level 1) FRA in the form of our standard template and which is attached to this letter.

The site is located in the London Borough of Richmond upon Thames. The proposed Planning Application involves the redevelopment of the Stag Brewery complex from industrial buildings to mixed use, to include residential, retail and restaurant, office, school, assisted living, hotel, museum, car park and associated landscaping. This is likely to involve some land raising.

Located approximately 12 km downstream of the tidal limit of the River Thames at Teddington Lock, flood risk to the site is predominantly tidal. Risk from other sources of flooding is considered low. As the site is protected by the Thames Tidal Defences, maintained to a high standard, the chances of the site being flooded are extremely low. The Thames Estuary 2100 Plan (TE2100) would ensure the defences would not be overtopped for the lifetime of any redevelopment. However, there is a residual risk that these defences will be breached.

We would be grateful if the Scoping FRA could be reviewed by London Borough of Richmond upon Thames Council. This will enable us to respond to any concerns in our Level 2 FRA. In the Level 2 Report, we will review the revised layout in relation to the requirements of NPPF in terms of finished floor levels, flood storage, drainage, access and sustainability.

In particular, we seek response to clarify:

- that the development provides wider sustainability benefits to meet the Exception Test;
- that flood storage compensation is not required, due to the entirely tidal nature of flood risk;
- whether the proposed evacuation route is suitable.

I trust that this is clear and I look forward to hearing from you.

Yours sincerely,

Dr Paul Webster BSc, MSc, PhD, DIC, C.WEM, MCIWEM
Head of Flood Management

Enc.

THE STAG BREWERY, MORTLAKE, DEVELOPMENT SCOPING FLOOD RISK ASSESSMENT FOR PRE-APPLICATION REVIEW (BASED ON NPPF PRACTICE GUIDANCE[2])

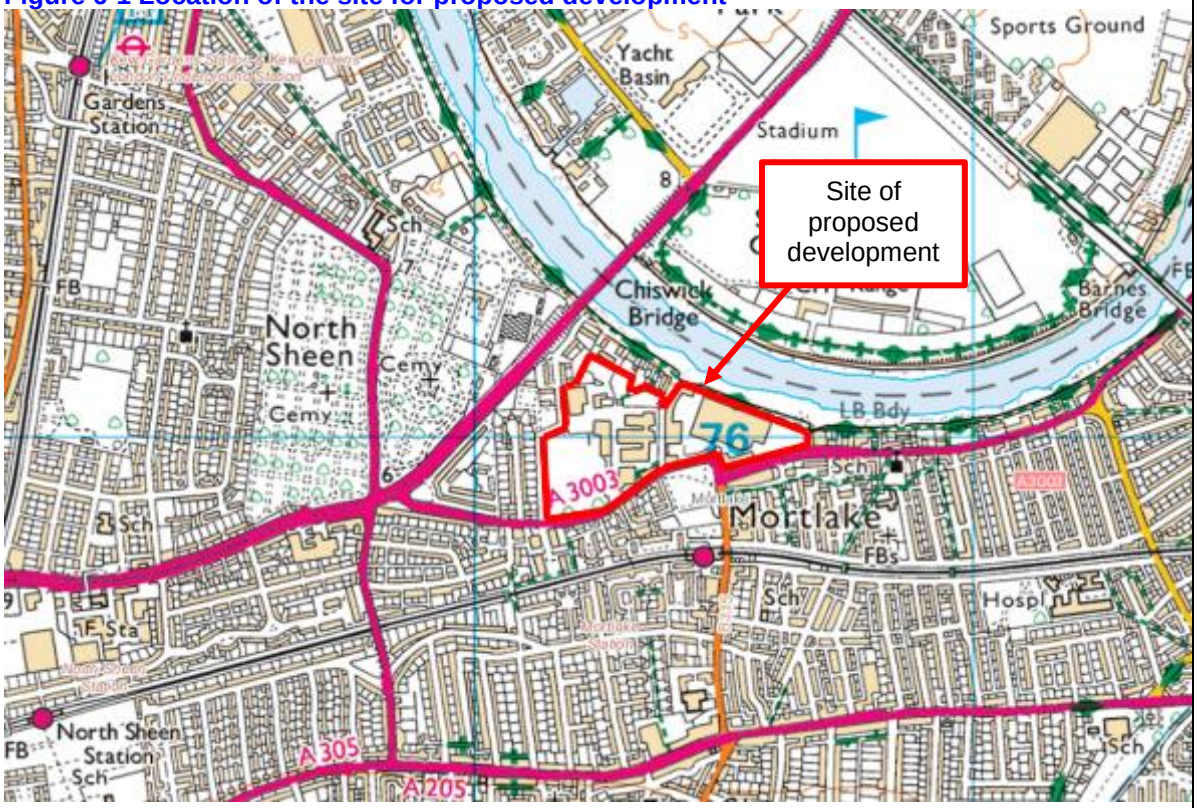
1 Development description and location

1a. What type of development is proposed and where will it be located?

- A location plan at an appropriate scale should be provided with the FRA, or cross referenced to the main application when it is submitted.

The location of the proposed development site, formerly that of the Stag Brewery, is in Mortlake, London Borough of Richmond upon Thames, (Figure 6-1). The area of the site is approximately 8 ha. The proposed Planning Application involves the redevelopment of the Stag Brewery complex from industrial buildings to mixed use residential and commercial. The site lies on the south bank of the River Thames, approximately 12 km downstream of the tidal limit at Teddington Lock. Vehicular access to the site is off the A3003 to the south, while there is also pedestrian access from the northwest to the A316 via a stairwell.

Figure 6-1 Location of the site for proposed development



1b. What is its vulnerability classification?

- Vulnerability classifications are provided in Table 2, NPPF Technical Guide

The vulnerability classification is currently 'Less Vulnerable' and will be 'More Vulnerable'.

1c. Is the proposed development consistent with the Local Development Documents?

- Where the site is allocated in an existing LDD the allocation should be referred to. Your Local Planning Authority planning officer should be able to provide site-specific guidance on this issue.

[2] http://planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/

Formal consultation on how the development fits with the LBRuT Local Plan is in progress.

1d. Please provide evidence that the Sequential Test or Exception Test has been applied in the selection of this site for this development type?

- Evidence is required that the Sequential Test has been used in allocating the proposed land use proposed for the site and that reference has been made to the relevant Strategic Flood Risk Assessment (SFRA) in selecting development type and design (See paragraphs 100-104, NPPF and paragraphs 3-5, NPPF Technical Guide). Your Local Planning Authority planning officer should be able to provide site-specific guidance on this issue.
- Where use of the Exception Test is required, evidence should be provided that both elements of this test have been passed (see paragraphs 102, NPPF and paragraphs 4-5, NPPF Technical Guide). Your Local Planning Authority planning officer should be able to provide site-specific guidance on this issue.

The sequential test is required to review if there are equivalent sites in Borough, currently available, at a lower risk of flooding. The Stag Brewery Supplementary Planning Document (LBRuT, 2011) sets out the planning brief for potential development at the site.

The site passes the Sequential Test as carried out by LBRuT, as there are no alternative sites for the proposed use in the borough (LBRuT, 2016).

There are two requirements for the Exception Test, namely that the development supports wider sustainability benefit to the community and that it can be safely developed without increasing flood risk elsewhere. The development is on previously developed land, though sustainability benefits are yet to be fully demonstrated. The issue of flood risk will be addressed by the detailed FRA to be prepared in due course.

1e. *[Particularly relevant to minor developments (alterations & extensions) & changes of use]* Will your proposal increase overall the number of occupants and/or users of the building/land; or the nature or times of occupation or use, such that it may affect the degree of flood risk to these people?

The change of use will increase the number of occupants.

2. Definition of the flood hazard

2a. What sources of flooding could affect the site? (see paragraph 2, NPPF Technical Guide).

- This may include hazards such as the sea, reservoirs or canals, which are remote from the site itself, but which have the potential to affect flood risk (see Section 1 of the NPPF Practice Guide).

Sources of flooding are summarised in Table 6-1*. The principal source of flood risk to the site is from the River Thames, which is entirely from tidal flooding, with no fluvial component. The site is in a defended area protected by flood defences, namely the Thames Tidal Defences. This comprises the embankment along the south bank of the Thames plus the Thames Barrier. Hence, the chances of the site being flooded are extremely low, especially since the defences are maintained to a high standard. Flood risk from other sources is considered low.*

Table 6-1 Sources of flooding which could affect the site

Key sources of flooding	***Possibility at Site***
Fluvial (Rivers)	*N/A*
Tidal	*The majority of the site is located within Flood Zone 3, with area in the north west in Flood Zone 2. Therefore, the site m be at risk of flooding from the tidal River Thames. However, t site is protected by the Thames Tidal Defences, which provic a Standard of Protection up to the 1 in 1000 year flood even the year 2070. Hence the risk of tidal flooding is very low.*
Groundwater	*No record in the SFRA (LBRuT, 2008).*
Sewers	*No record in the SFRA (LBRuT, 2008), or identified consultation with the EA and LBRuT.*
Surface water	*Parts of the site are at low risk of surface water flood according to the Environment Agency surface water flood ma with an area to the southwest of the site at medium risk.*
Infrastructure failure	*There is a residual risk that the Thames Tidal Defences will breached.*

Based on NPPF Practice Guide

2b. For each identified source, describe how flooding would occur, with reference to any historic records wherever these are available.

- An appraisal of each identified source, the mechanisms that could lead to a flood occurring and the pathways that flood water would take to, and across, the site.
- Inundation plans, and textural commentary, for historic flood events showing any information available on the mechanisms responsible for flooding, the depth to which the site was inundated, the velocity of the flood water, the routes taken by the flood water and the rate at which flooding occurred.

Despite the site being defended from tidal flooding, an extreme storm surge could breach or overtop the flood defences.

Breach modelling, undertaken by the EA, shows that some parts of the site could be affected if the defences were to fail (Figure 6-2). Model nodes are shown in Figure 6-3, with the predicted levels at each node summarised in Table 6-2. It can be seen that the future breached flood level at the site could reach 6.03 mAOD by 2100.

Figure 6-2 EA Modelled Tidal Breach Flood Extents

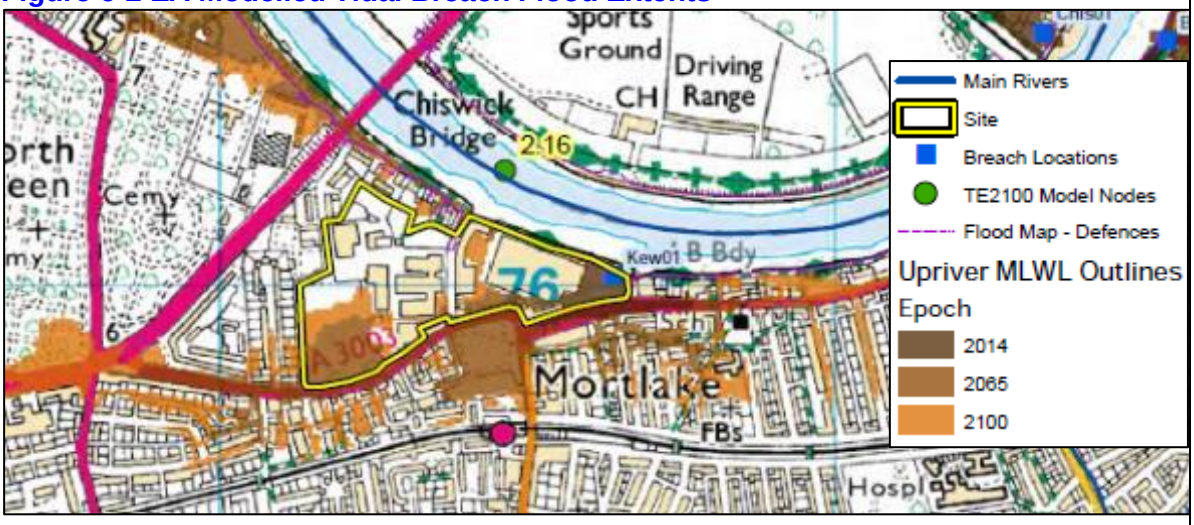


Figure 6-3 EA Tidal Breach Model Nodes

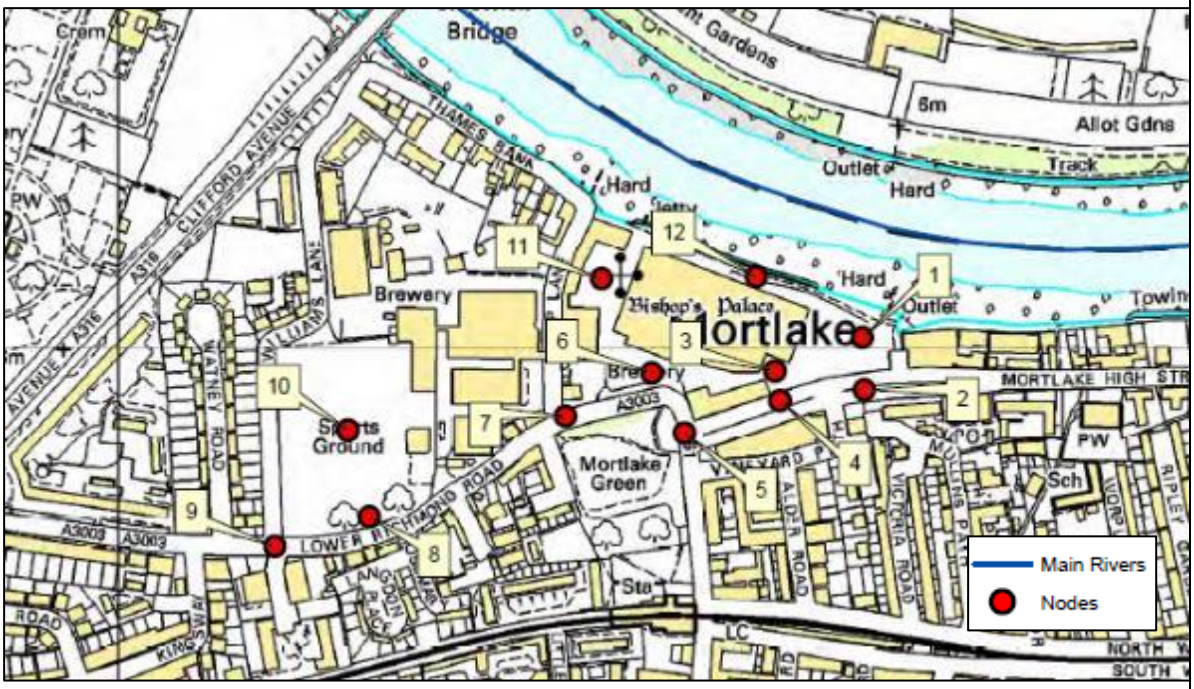
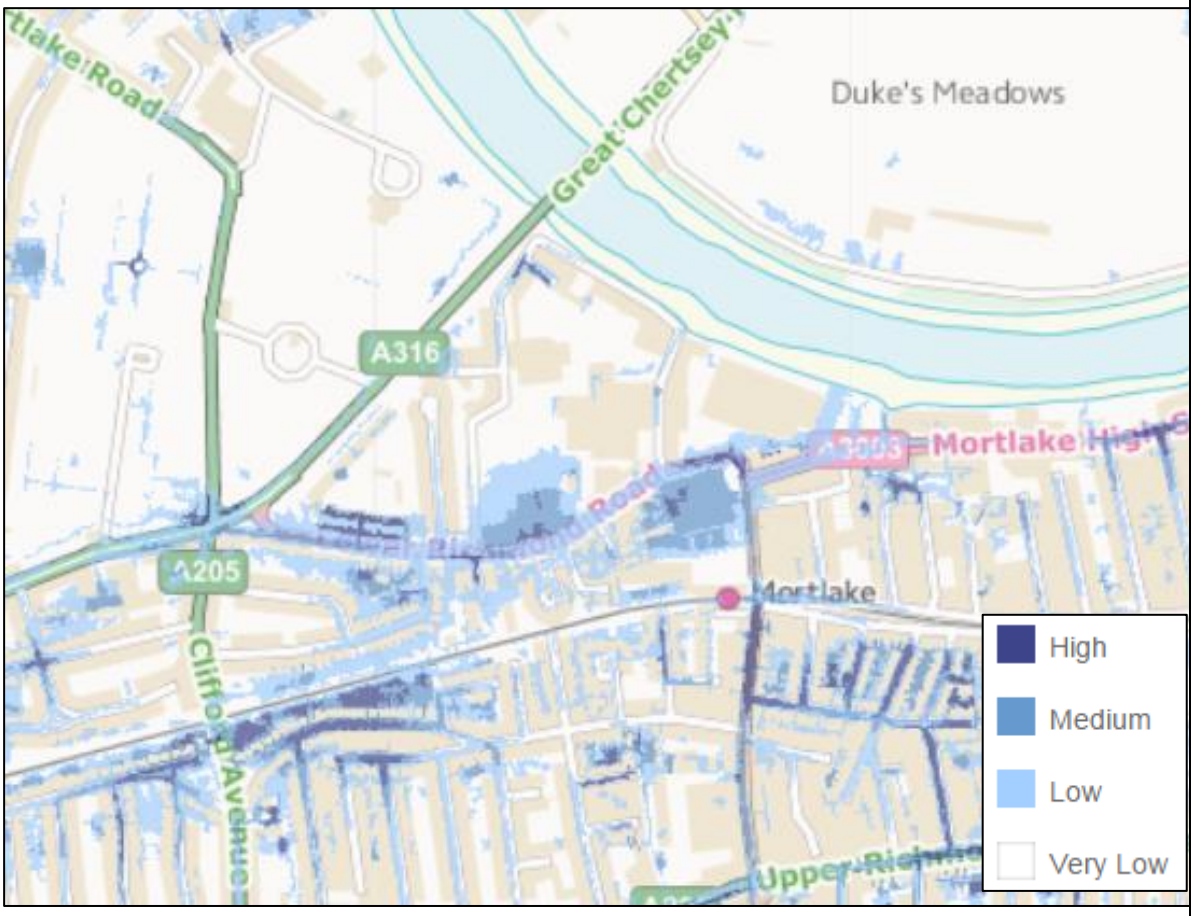


Table 6-2 Modelled Tidal Breach Levels for EA Model Nodes

Node	Modelled breach levels (mAOD)		
	2014	2065	2100
1	5.17	5.74	6.00
2	5.18	5.75	6.01
3	5.19	5.74	6.01
4	5.19	5.74	6.01
5	5.01	5.72	5.97
6	Nil Return	5.72	5.97
7	Nil Return	5.72	5.97
8	Nil Return	5.33	5.63
9	Nil Return	5.31	5.60
10	Nil Return	5.33	5.63
11	Nil Return	Nil Return	6.03
12	5.23	5.78	6.03

The EA's Risk of Flooding from Surface Water map (Figure 6-4) indicates that the majority of the site is at a 'very low' risk of surface water flooding. However, there are some areas, mostly in the south of the Site, that are shown to be at a 'low' to 'high' risk of flooding. It should be noted that this mapping is course in nature and is not appropriate for Site specific assessments.

Figure 6-4 EA Areas at Risk of Surface Water Flooding



2c. What are the existing surface water drainage arrangements for the site?

- Details of any existing surface water management measures already in place, such as sewers and drains and their capacity.

Existing sewers crossing the site include a 225 mm diameter foul sewer in the northwest of the site, a 686 mm diameter combined sewer along the north eastern boundary, and two foul rising mains used to discharge trade effluent from the brewery.

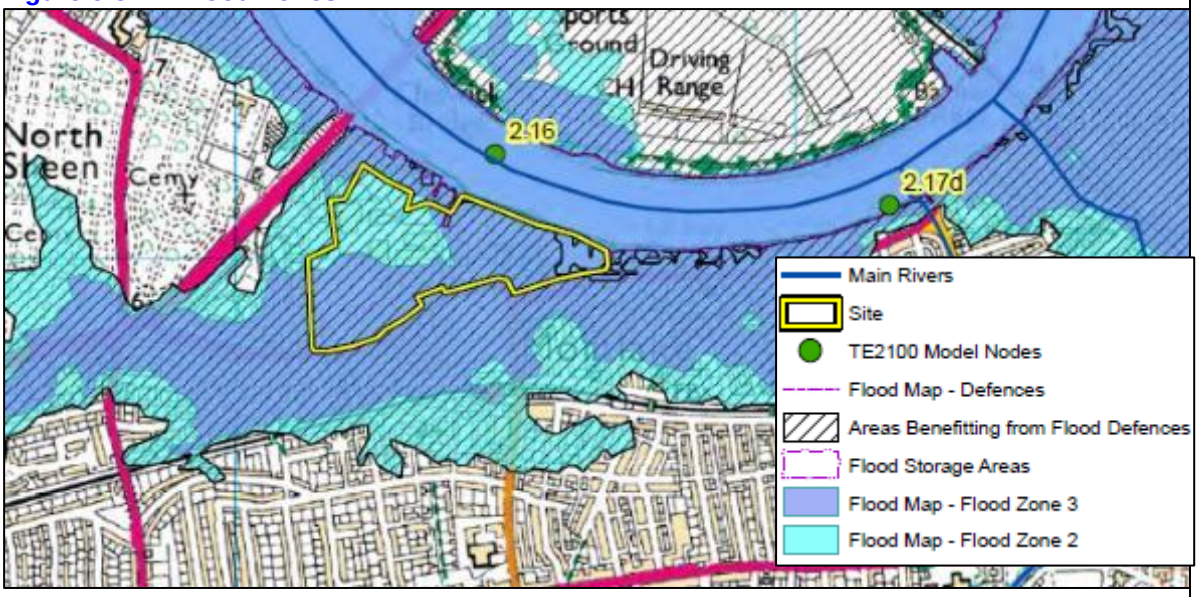
3. Probability

3a Which flood zone is the site within?

- The flood zones are defined in Table 2, NPPF Technical Guide.

The EA Flood Map for Planning shows the majority of the site is located within defended Flood Zone 3, with an area in the north west in Flood Zone 2 (Figure 6-5).

Figure 6-5 EA Flood Zones

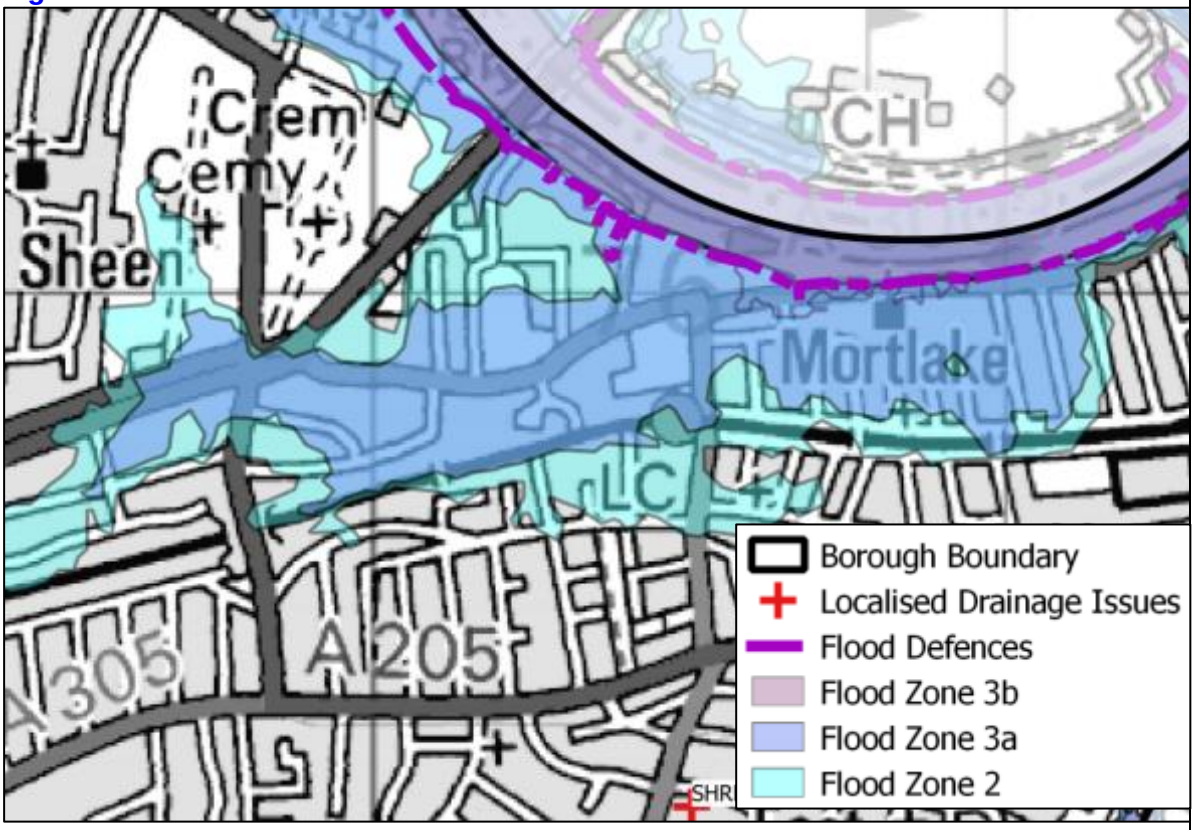


3b If there is a Strategic Flood Risk Assessment covering this site, what does it show?

- The planning authority can advise on the existence and status of the SFRA.

The SFRA confirms that the majority of site lies in Flood Zone 3, with an area in the north west in Flood Zone 2 (Figure 6-6).

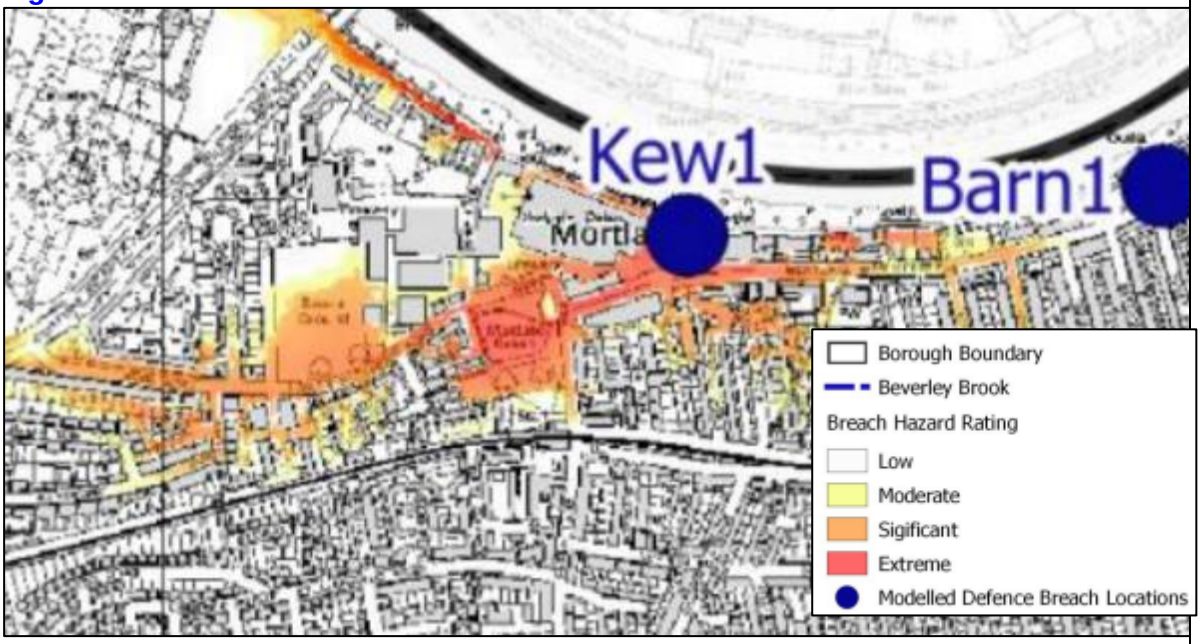
Figure 6-6 SFRA Flood Zones



As part of the SFRA, hydraulic modelling was carried out to consider the general velocity, depth and path of flood water should the Thames Tidal Defences fail. However, unlike the

EA breach modelling, the results do not provide detailed information of site-specific relevance in terms of these variables. Instead, flood hazard levels are provided, which show the site to encompass the range of breach hazard ratings from low to extreme. For the purposes of the FRA, the EA breach model is considered more appropriate.

Figure 6-7 SFRA Tidal Breach Flood Hazard



3c What is the probability of the site flooding taking account of the contents of the SFRA and of any further site-specific assessment?

This may need to include

- a description of how any existing flood risk management measures affect the probability of a flood occurring at the site FRA Pro-forma
- supporting evidence and calculations for the derivation of flood levels for events with a range of annual probability
- inundation plans of, and cross sections through, the existing site showing flood extents and levels associated with events with a range of annual probability
- a plan and description of any structures which may influence the probability of a flood occurring at the site. This may include bridges, pipes/ducts crossing a watercourse, culverts, screens, embankments or walls, overgrown or collapsing channels and their likelihood to choke with debris.
- details of any modelling studies completed to define the exiting degree of flood risk

It is considered that the probability of the site flooding is extremely low, only occurring in the event of a breach in the flood defences. In this event, and in the absence of site-specific data from the SFRA, please see Section 2b for details on levels.

3d What are the existing rates and volumes of run-off generated by the site?

- This should generally be accompanied by calculations of run-off rates and volumes from the existing site for a range of annual probability events (see Section 21 of the NPPF Practice Guide).

The development concept shows a reduction in impermeable area from the existing/pre-development situation. Post-development runoff will be lower than pre-development runoff, which the FRA will quantify. Runoff rates will be compared with the SFRA target of a reduction of 50% over current levels.

4. Climate change

How is flood risk at the site likely to be affected by climate change?

- Paragraphs 11-15, of the NPPF Technical Guide provide guidance on how to assess the impacts of climate change.

Invoking the DEFRA assumptions relating to climate change will see an increase of river discharges and flood water levels. Similarly, rates of precipitation intensity are forecast to increase. Model data provided by the Environment Agency will make use of current climate change assumptions. Any drainage design work will make use of appropriate assumptions for climate change.

5. Detailed development proposals

Where appropriate, are you able to demonstrate how land uses most sensitive to flood damage have been placed in areas within the site that are at least risk of flooding, including providing details of the development layout?

- Reference should be made to vulnerability classification, Table 2 of the NPPF Technical Guide.
- Section 4 of the NPPF Practice Guide provides guidance on how the sequential approach can be used to inform the lay-out of new development sites.

The proposed development is shown in Figure 6-8. It consists of a number of residential and commercial units, a school in the southwest of the site, and associated landscaping. The key features of the development are:

- *Remodelling of the tidal defences to improve appearance and visual impact*
- *Residential units*
- *Retail and restaurant outlets*
- *A school with the existing playing field retained*
- *A hotel*
- *A museum in the old boat house*
- *Offices*
- *A cinema and gym*
- *Assisted living*
- *Car parking*

The development concept is still being refined and will be reviewed in detail in the full FRA.

In preparing the full FRA, due consideration will be taken of:

- *Some raising of ground in the lowest part of the site (eastern boundary),*
- *The location of the existing tidal defences and the requirements for Environmental Permitting for work within 16 m of the defences. We note, for example, the extent of the defences along Ship Lane,*
- *A surface water management plan following SuDS principles (see Section 7b)*
- *Safe access and egress to and from the site (see Section 8).*

Figure 6-8 Proposed Development Layout

6. Flood risk management measures

How will the site be protected from flooding, including the potential impacts of climate change, over the development's lifetime?

- This should show that the flood risk management hierarchy has been followed and that flood defences are a necessary solution. This should include details of any proposed flood defences, access/egress arrangements, site drainage systems (including what consideration has been given to the use of sustainable drainage systems) and how these will be accessed, inspected, operated and maintained over the lifetime of the development. This may need to include details of any modelling work undertaken in order to derive design flood levels for the development, taking into account the presence of any new infrastructure proposed.

Although the development contains areas of raised land, it is anticipated there will be no requirement for flood storage compensation. This is due to the entirely tidal nature of the flood risk.

The site can be protected from flooding by setting floor levels and access/egress at appropriate level. The finished floor level will need to be at the 2100 design flood level plus a freeboard. With a freeboard of about 300 mm (0.3 m), the likely finished floor level is 6.33 mAOD.

The Thames Estuary 2100 Plan (TE2100) (EA, 2012), would seek to ensure that the defences are not overtopped for the lifetime of any redevelopment on the Site.

Modelled flood levels and associated statutory defence levels for the River Thames adjacent to the Site, both for the present day and in the future, are summarised in Table 6-3. The present day extreme water level in the River Thames is 5.23m AOD, rising to 6.03m AOD when the impacts of climate change up to the year 2100 are taken into account. The site will be protected up to the 1 in 1000 year standard until 2100 by the River Thames defences.

Table 6-3 TE2100 In-channel Design Flood Levels and Defence Levels (mAOD)

EA Flood Modelling Node	Present Day		2065 to 2100		2100	
	Design Flood Level	Defence Level	Design Flood Level	Defence Level	Design Flood Level	Defence Level
2.16	5.23	5.94	5.59	6.25	6.03	6.70

7. Off site impacts

7a How will you ensure that your proposed development and the measures to protect your site from flooding will not increase flood risk elsewhere?

This should be over the lifetime of the development taking climate change into account. The assessment may need to include:

- Details of the design basis for any mitigation measures (for example trash screens, compensatory flood storage works and measures to improve flood conveyance). A description of how the design quality of these measures will be assured and of how the access, operation, inspection and maintenance issues will be managed over the lifetime of the development.
- Evidence that the mitigation measures will work, generally in the form of a hydrological and hydraulic modelling report.
- An assessment of the potential impact of the development on the river, estuary or sea environment and fluvial/coastal geomorphology. A description of how any impacts will be mitigated and of the likely longer-term sustainability of the proposals.

There should be no requirement for flood storage compensation, as the flood risk is entirely tidal in origin. No hydraulic modelling work is deemed to be necessary in support of this FRA.

7b How will you prevent run-off from the completed development causing an impact elsewhere?

- Evidence should be provided that drainage of the site will not result in an increase in the peak rate or in the volumes of run-off generated by the site prior to the development proceeding.

A number of options will be reviewed in the FRA, following a SuDS train.

The preferred drainage solution would be to discharge surface water runoff to the ground. However, the ground conditions and likelihood of high groundwater due to the adjacent River Thames may preclude the use of infiltration techniques.

Another option would be to discharge surface water runoff directly to the River Thames. As the River Thames is tidal, surface water runoff could discharge to it unrestricted, with no formal attenuation required. Design would need to consider tide locking at the outfall.

The least preferred option would be to discharge to a Thames Water surface water sewer, ultimately connecting to the River Thames.

8. Residual risks

8a What flood-related risks will remain after you have implemented the measures to protect the site from flooding?

- Guidance on residual risks is provided in Section 14 of the NPPF Practice Guide.

There is a residual risk that the Thames Tidal Defences will be breached.

The FRA will review the following (from PPS25 Practice Guide #7.8):

1. *Flood resilience and resistance.*
2. *Flood warning and evacuation.*
3. *Sustainable drainage for extreme events.*

8b How, and by whom, will these risks be managed over the lifetime of the development?

- Reference should be made to flood warning and evacuation procedures, where appropriate, and to likely above ground flow routes should sewers or other conveyance systems become blocked or overloaded. This may need to include a description of the potential economic, social and environmental consequences of a flood event occurring which exceeds the design standard of the flood risk management infrastructure proposed and of how the design has sought to minimize these – including an appraisal of health and safety issues.

The proposed emergency evacuation route, in the event of an extreme event and breach in the defences is shown in Figure 6-9. This takes account of the flood hazard to the A3003.

Figure 6-9 Proposed Evacuation Route

The FRA will consider the following for residual risk (PPS Practice Guide #7.10):

1. *Depth of flooding on access/egress routes.*
2. *Speed of flow on access/egress routes.*
3. *Local flow paths*
4. *Speed of onset of flooding*
5. *Distance from defences*
6. *Duration of flood.*

References

Author	Date	Title/Description
Centre for Ecology and Hydrology.	2009	The Flood Estimation Handbook CD-ROM 3. Centre for Ecology & Hydrology, Wallingford, Oxon, UK.
CIRIA	2007	The SUDS Manual - CIRIA Report C697.
DCLG	Mar 2012(a)	National Planning Policy Framework.
DCLG	Mar 2012(b)	Technical Guidance to the National Planning Policy Framework.
DCLG		NPPF Practice Guide, Flood Risk. Available from: http://planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/
DEFRA / Environment Agency	2013	Rainfall Runoff Management for Development Report SC030219
Environment Agency	2012	Thames Estuary 2100 Plan: Managing flood risk through London and the Thames estuary
Institute of Hydrology	1999	Flood Estimation Handbook,

London Borough of Richmond upon Thames	2008	Strategic Flood Risk Assessment (SFRA)
London Borough of Richmond upon Thames	2011	Supplementary Planning Document: Stag Brewery, Mortlake, SW14 Planning Brief
London Borough of Richmond upon Thames	2016	Flood Risk Sequential Test to Support the Local Plan Pre-Publication version
Marshall D.C.W. & Bayliss A.C	1994	Flood estimation for small catchments, IH Report No. 124, Institute of Hydrology, Wallingford and Hall, Hockin & Ellis

Appendix C Responses to Scoping Level Report

The Scoping Level Report (Appendix B) was submitted in July 2016 for pre-application review, with responses received the following month.

C.1 Environment Agency Response

creating a better place

Environment Agency

Dr Paul Webster
HydroLogic Services
18-20 West End Road
Mortimer Common
Reading
RG7 3TF

Our ref: SL/2016/116146/01-L01
Your ref: Email 25/07/2016

Date: 25 August 2016

Dear Dr Webster,

Redevelopment of the Stag brewery complex from industrial buildings to mixed use residential and commercial at the Stag Brewery site, Mortlake, SW14 7QU

Thank you for consulting the Environment Agency for pre application advice on producing a Flood Risk Assessment at this site. Its essential flood risk and climate change issues and opportunities are integrated into the overall design and layout of this site and not considered in isolation.

There are major opportunities to create an improved riverside environment and improve connections to the river in line with London Borough of Richmond local plan policies for this site and "make space for water". The key Environment Agency issues and opportunities at this site are:

- Flood risk management, flood defences and TE2100 climate change actions – the site is located in a high risk flood zone with opportunities to improve the standard and appearance of the flood defences
- Riverside enhancements and improved biodiversity – adjacent to the River Thames and opportunities exist for new tidal terracing and 16 metre buffer zone and create a more natural riverside environment. Across the Thames Estuary only around 2% of the tidal banks are natural
- High standards of sustainable design and construction including sustainable drainage and land remediation

We have provided detailed feedback in Section 1 on the Flood Risk Assessment and improving the riverside environment as part of this redevelopment. A Water Framework Directive assessment should be completed demonstrating how the development will deliver an improved water environment.

We hope our response is helpful, if you require any additional information please contact Joe Martyn at ksiplanning@environment-agency.gov.uk

Yours sincerely

James Togher
Team Leader

Environment Agency, Ergon House, Horseferry Road, London, SW1P 2AL
03708 506 506
ksiplanning@environment-agency.gov.uk
www.gov.uk/environment-agency

Section 1 – Detailed feedback

1.1 - Flood risk management and climate change

After reviewing the level 1 FRA for the Stag Brewery redevelopment proposal, we have several comments that we would like clarification upon. We understand that some of these queries will be addressed when a more detailed FRA is submitted and are keen to continue discussing these points during the pre application process.

- As the development will occupy a significant stretch of the Thames Tidal Defences, we would expect to see the height of the existing defences raised to the TE2100 level of 6.70 metres as part of the proposed works. Similarly it would be expected that the condition of existing defences would be improved as part of this development. In some areas the current condition is deemed 'poor' by our Asset Performance team – something that would need to improve in order for us to approve a development of this stature in such close proximity to the Thames. These actions would significantly reduce flood risk to the site for the entirety of its lifetime. You should consider opportunities to introduce an improved riverside environment at this site for example new tidal terracing and improving the Thames path as part of the redevelopment. Good practice examples of tidal terracing exist along the River Thames at other regeneration sites such as Greenwich Peninsula. (see section 1.2 below for more information on improving the riverside environment, this could be integrated with a Sustainable Drainage scheme across the site).

- We would also like detailed clarification on what appears to be two boat house/wharf structures that extend out into the Thames in Figure 8 (page 10). We encourage developers to "make space for water" and not develop into the river with new structures which can be located on land. Local plan policy supports this approach and we are likely to object to any proposed "encroachment" into the river channel. Its important the redevelopment of this key riverside introduces a 16 metre buffer zones between new development and the river edge to create an improved river corridor for people and wildlife.

- It is crucial that we know the proximity of the site in relation to the existing Thames Tidal Defences. Currently the boundary wall of the brewery along the Thames forms part of the flood defence here and would therefore have to be taken into account in the proposed design. The location of works is also likely to result in the need for an environmental permit to be issued by the Environment Agency for the site since it appears works will be carried out within 16 metre of the current defences. Information regarding the new Environmental Permitting system can be found here: (https://www.gov.uk/guidance/flood-risk-activities-environmental-permits)

- Finally as part of the detailed FRA, and in order for us to approve the application, we would require high-detail design plans including all relevant finished floor levels alongside a detailed site-specific assessment of flood risk in particularly in a breach scenario. We appreciate you have taken into account the TE2100 in-channel design flood levels when setting finished floor levels and will request that these levels are a regarded as a minimum for any properties within the development. We can confirm that as the site is only at risk of tidal flooding flood storage compensation will not be required

Environment Agency, Ergon House, Horseferry Road, London, SW1P 2AL
03708 506 506

kslplanning@environment-agency.gov.uk
www.gov.uk/environment-agency

In addition, we recommend that you take into account the following information regarding flood resilient measures and emergency planning throughout development of this application:

Flood resistant and resilient measures:
We recommend that consideration be given to the use of flood resistant and resilient measures – such as barriers on doors, windows and access points at the ground floor level and routing electrical services from a higher level downwards so that plug sockets are located above possible flood levels – within the proposed development, in order to reduce the impact of flooding. We further recommend consultation with the local building control department when determining whether particular flood resistant and resilient measures are appropriate and effective.

Please refer to the following resources for further guidance on flood resistant and resilient measures:
Department for Communities and Local Government (DCLG) – formerly Office for the Deputy Prime Minister (ODPM) – document 'Preparing for floods: Interim guidance for improving the flood resistance of domestic and small business properties';
Department for Communities and Local Government (DCLG) document 'Improving the flood performance of new buildings: flood resilient construction'.

Evacuation Plan
The Environment Agency does not typically comment on, or approve the adequacy of, flood emergency response procedures accompanying development proposals, because we do not carry out such roles during a flood event. Our involvement with the proposed development during an emergency will be limited to delivering flood warnings to occupants or users covered by our 'FloodLine' service.

The applicant should take advice from the emergency services when producing an emergency response plan (or evacuation plan) for the proposed development as part of the FRA, as stated in the Planning Practice Guidance[1].

We advise local planning authorities to formally consider the emergency planning and rescue implications of development proposals when making their decisions, particularly in any circumstances where warning and emergency response are fundamental to managing flood risk.

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[1] http://planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/making-development-safe-from-flood-risk/what-are-the-important-considerations-for-flood-warning-and-evacuation-plans/

Environment Agency, Ergon House, Horseferry Road, London, SW1P 2AL
03708 506 506

ksiplanning@environment-agency.gov.uk
www.gov.uk/environment-agency

1.2 - Improving the riverside environment and linkages to the River Thames

This is a major riverside development site and an excellent opportunity to improve linkages to the River Thames and quality of the Thames Path in this area. If the old brewery is being demolished this creates opportunities to set the new buildings 16 metres back from the river edge, create tidal terracing or tidal inlets at this location and upgrade the Thames Path.

For more information on tidal terracing and set back defences view the Estuary Edges guidance, this includes examples of good practice sites such as Greenwich Peninsula and Battersea Reach. The Estuary Edges Guidance document is a 'how to' guide on ecological design for soft natural riverbank edges to encourage wildlife on the Thames. We recommend visiting good practice sites and viewing the development from a boat in the river to see what can be achieved on riverside sites like this.
http://thamesestuarypartnership.org/our-projects/estuary-edges/

In the Thames Estuary only around 2% of the tidal banks are natural. Increasing natural riverbanks will have a significant positive ecological impact on the river and will help restore fish stocks. The development should protect and enhance the local environment and seek opportunities to deliver ecological enhancements and improve linkages to the River Thames.

We encourage developers to include a naturalised buffer zone along the river. The development should take the opportunity to naturalise and existing hard engineered river bank and set new building away from the River Thames. We seek a 16 metre buffer zone between new developments and the River Thames to "create space for water."

You will need to consider the requirements of the Water Framework Directive (WFD) which includes causing no overall deterioration in water quality or the ecological status of any waterbody. Information on WFD and the current status of water bodies can be found in the Thames River Basin Management Plan
https://www.gov.uk/government/collections/river-basin-management-plans-2015

Development close to rivers should help to deliver the objectives of the Water Framework Directive to improve riverside environments like this site. This includes applying mitigation measures (improvements to the river) identified in the river basin management plan (RBMP). This is an excellent opportunity for partnership working and funding to improve the river corridor in this area. We recommend discussing proposals for this site with local residents and river user groups such as Your Tidal Thames
http://www.thames21.org.uk/project/your-tidal-thames/

It is a requirement of WFD to deliver a significant net gain for biodiversity, and ideally this should be along the riverside, where it would deliver maximum benefits. A Water Framework Directive Assessment should be submitted with the planning application, this assessment will be expected for any extensive works within the byelaw margin.

Protection and enhancement of the River Thames is supported in the Richmond Local Plan development management policies and the Supplementary Planning Document for the Stag Brewery site http://www.richmond.gov.uk/stag_brewery_2010-2.pdf

Environment Agency, Ergon House, Horseferry Road, London, SW1P 2AL
03708 506 506

kslplanning@environment-agency.gov.uk
www.gov.uk/environment-agency

1.3 Sustainable design and construction

Sustainable drainage systems
The opportunities to introduce a sustainable drainage systems should be used to inform the site layout and design and included in your Flood Risk Assessment. The Environment Agency no longer comments on SuDs and you should discuss this with Richmond council as the Lead Local Flood Risk Authority. You should maximise opportunities across the site for example green roofs, walls and permeable paving / storage areas. For more information on SuDS click below:
http://www.susdrain.org/delivering-suds/using-suds/background/sustainable-drainage.html

We have produced advice with Natural England and the Forestry Commission on how new development can help improve the environment. This is in line with the national planning policy framework (NPPF).

"*the planning system should contribute to and enhance the natural and local environment*" (Para 109). https://www.gov.uk/government/publications/planning-a-guide-for-developers

Land contamination
Due to the former landuse as a brewery and industrial site there is potential for contamination at this riverside site. We recommend:

- Follow the risk management framework provided in CLR11, 'Model Procedures for the Management of Land Contamination', when dealing with land potentially affected by contamination;
- Refer to our 'Guiding Principles for Land Contamination' documents for the type of information that should be included in a Preliminary Risk Assessment (PRA;
- Refer to our 'Groundwater Protection: policy and practice (GP3)' documents
- We will require a PRA to assess if land contamination may be present at the site. This should be submitted with the planning application. The PRA needs to include information on past and current uses, if sensitive controlled waters receptors are present and if the site could pose a pollution risk. The PRA should also consider if any aspects of the proposed development could pose a pollution risk should contamination be present (i.e. deep drilling to facilitate the installation of foundation piles, site drainage). Further work such as an intrusive site investigation may be required depending on the findings of the PRA.

Please note that the view expressed in this letter by the Environment Agency is a response to a pre application enquiry only and does not represent our final view in relation to any future planning application made in relation to this site. We reserve the right to change our position in relation to any such application. You should seek your own expert advice in relation to technical matters relevant to any planning application before submission.
This opinion is based on the information submitted and current planning policy and guidance

Environment Agency, Ergon House, Horseferry Road, London, SW1P 2AL
03708 506 506

kslplanning@environment-agency.gov.uk
www.gov.uk/environment-agency

C.2 LBRuT Response

From: Andrea Kitzberger-Smith [mailto:Andrea.Kitzberger@richmond.gov.uk]
Sent: 28 July 2016 16:04
To: Kevin Watson KWatson@geraldeve.com
Cc: Lucy Thatcher <L.Thatcher@richmond.gov.uk>; Neil Henderson <NHenderson@geraldeve.com>; planning.se@environment-agency.gov.uk; joseph.martyn@environment-agency.gov.uk
Subject: RE: Stag Brewery - Flood Risk scoping

Hi Kevin

I've now reviewed the Level 1 Flood Risk Scoping report (Ref. K0685/ah). Below are my comments based on what has been submitted:

- Sequential Test: We have produced a Flood Risk Sequential Test report in support of the draft Local Plan: http://www.richmond.gov.uk/local_plan_flood_risk_sequential_test_report.pdf. This states in relation to Stag Brewery that *"This is a site for major redevelopment and regeneration as the brewery has closed, and as such, it is not appropriate / possible to accommodate the proposed uses on an alternative site in the borough at lower probability of flooding. The sequential approach should be applied on the site and a site-specific FRA will be required. Flood Hazard and TE2100 levels will need to be taken into account."* Therefore, the Council considers that this site has passed the Sequential Test. Note that we are awaiting comments from the Environment Agency on this report.

- Exception Test: As it has been correctly identified, this proposal will need to be subject to the Exception Test, of which there are 2 parts: (1) wider sustainability benefits and (2) a site-specific Flood Risk Assessment (FRA) to demonstrate that it can be safely developed without increasing flood risk elsewhere. In relation to the first part of the Test, the Council can confirm that development of this site in line with the draft Local Plan proposal site (SA23), as supported by the Flood Risk Sequential Test, will provide wider sustainability benefits because it is now a derelict site that is in need of regeneration, and the proposal will create a new village heart for Mortlake with a mix of uses, including enlivening the riverside frontage.

- It should be acknowledged that the proposal will increase the number of not only occupants but also users of the building/land. This will be an important aspect to address in both the FRA and Flood Emergency Plan.

- Council's updated SFRA: Attention is drawn to the recently updated and published Council Strategic Flood Risk Assessment (2016): http://www.richmond.gov.uk/flood_risk_assessment, which needs to be taken into account. (I note the reference to the 2008 version, which has been updated twice since its first publication.)

- Flood Hazard: I note the scoping paper includes hazard and breach level information. The technical data contained within this will need to be verified by the Environment Agency. Attention is drawn to the Council's SFRA (2016), which contains information on flood hazard that needs to be taken into account. The tidal breach flood hazard area shows that parts of the site are within the moderate, significant and extreme

hazard areas. This will need to be addressed in the site-specific FRA, particularly as the secondary school is proposed to be located in an area at 'significant' hazard.

- Groundwater: The SFRA (2016) contains more information on groundwater in comparison to its previous version. In particular, the BGS Susceptibility to Groundwater Flooding map shows that at the location of the Stag Brewery site, there is some potential for groundwater flooding to occur at surface as well as below ground. This will need to be considered and assessed in the FRA.

- Other sources of flooding: The updated SFRA (2016) contains more detail on other historic flooding incidents, such as blocked gulleys/drains, which should be taken into account.

- TE2100: The proposal has to take into account the requirements of the Thames Estuary 2100 (TE2100) Plan with regard to the implementation of current and future improvements to the River Thames tidal flood defences in order to effectively manage tidal flood risk. It is strongly recommended to liaise with the Environment Agency in this regard to ensure the development takes account / will be able to adapt to these requirements.

- Flood defences: I note that remodelling of flood defences forms part of the proposal. This will need to be discussed and agreed with the Environment Agency. The Council, in conjunction with the Environment Agency, will require a buffer zone of 16 metres for the tidal Thames and policies seek to set back developments from river banks and existing flood defence infrastructure where possible.

- Surface water and drainage: I note that the development concept shows a reduction in impermeable area and reference is made to the SFRA target of a reduction of 50% over current levels. Note that the SFRA has been updated and it is expected that the development proposal complies with existing policies, which seek greenfield run-off rates. If greenfield run-off rates cannot be achieved, it will need to be demonstrated by the applicant why it cannot be achieved. The minimum requirement is to achieve at least a 50% attenuation of the site's surface water runoff at peak times based on the levels existing prior to the development. I note the reference to following a SuDS train – it should be noted that there are SuDS techniques which do not require infiltration, and therefore the applicant should follow policy DM SD 7 as well as the borough-specific guidance set out in the Planning Guidance Document 'Delivering SuDS in Richmond' (2015):
http://www.richmond.gov.uk/sustainable_drainage_systems.pdf
A Statement on Sustainable Drainage Systems (SuDS) / Surface Water Drainage Strategy will have to be submitted with any planning application. The Council in its function as the Lead Local Flood Authority will be consulted on this, and their approval will be sought.

- Finished floor levels (FFL) and freeboard: I note the consultant refers to providing a freeboard of 300mm. Whilst the modelled flood levels and technical data included within the report will need to be confirmed and verified by the Environment Agency, my understanding is that the revised TE2100 tidal flood levels include an allowance for modelling uncertainty and therefore do not require the freeboard to be added. Therefore, your proposed FFL may be overly conservative and a level of 6.03 mAOD may suffice. However, this will need to be confirmed by the Environment Agency, who I understand are in the process of revising guidance on freeboard allowances.

- Climate change allowances: The Climate Change Allowance guidance has been updated and published https://www.gov.uk/guidance/flood-risk-assessments-climate-

change-allowances - please liaise with the Environment Agency as my understanding is that the revised EA guidance for climate change allowances should be applied for fluvial and surface water flooding, but they do not apply for tidal flooding as they are already accounted for in the model of the Thames Estuary 2100 plan.

- Flood Emergency Plan and proposed Evacuation Route: In line with policy DM SD 6, all proposals on sites of 10 dwellings or 1000sqm of non-residential development or more are required to submit a Flood Warning and Evacuation Plan. The Council's guidance on 'Producing a Flood Emergency Plan' (2011) should be followed: http://www.richmond.gov.uk/final_guidance_on_producing_a_flood_emergency_plan_nov_2011.pdf. Drawings showing the height of the route/road in comparison to the modelled extreme water levels will be required in this regard, including the designated safe place of refuge (which appears to be off-site). At this point, the Council is unable to confirm whether the proposed evacuation route is suitable, particularly as this is currently a non-existing route through the development site, of which the design/layout may change as a result of negotiations and discussions on the overall development scheme.

- Planning policies: The FRA and Drainage Statement will need to demonstrate compliance with existing planning policies as contained within the London Plan as well as the Council's Core Strategy (i.e. policy CP 3 in particular) and Development Management Plan (i.e. policies DM SD 6, 7 and 8 in particular). In addition, national guidance is set out in the NPPF and PPG. Also note that the Council is currently reviewing its existing policies and a draft Local Plan has been published for public consultation. Particular attention is drawn to draft policy LP 21 (Flood Risk and Sustainable Drainage). Note that in line with the NPPF, the emerging Local Plan will be given weight in the decision making process according to its stage of preparation (i.e. the more advanced the preparation, the greater the weight that may be given). Therefore, when the Local Plan reaches Publication stage, currently expected to be in late Autumn 2016, greater weight will be given to the Local Plan, including its policies and proposal sites.

- Basements and subterranean developments: Note that the updated SFRA (2016) and draft policy LP 21 contain specific guidance and requirements in relation to basements and subterranean developments. In areas of
Extreme, Significant and Moderate breach hazard (as set out in the Council's SFRA), within flood zone 3a (tidal), new basements will be restricted to Less Vulnerable / Water Compatible uses only. Therefore, basements for residential uses will not be allowed.

I note that Hydro-Logic Services are particularly seeking to clarify the following (my comments are in yellow highlight):

a. that the development provides wider sustainability benefits to meet the Exception Test – Yes, for the reasons set out above
b. that flood storage compensation is not required, due to the entirely tidal nature of flood risk – to be discussed and agreed with the Environment Agency; my understanding is that for development in a defended flood risk area, compensatory storage should not be necessary when raising ground levels due to the unlikely impact on maximum tidal levels. However, the impact on residual flood risk to other properties (i.e. off-site) needs to be considered as new development behind flood defences can increase the residual risk of flooding if the flood defences are breached by changing the conveyance of the flow paths or by displacing flood water elsewhere.
c. whether the proposed evacuation route is suitable – to be confirmed once a Flood Emergency Plan has been produced and the proposal developed further (see comments above)

Kind regards

Andrea Kitzberger-Smith
Planning Policy Manager

London Borough of Richmond upon Thames
Second Floor | Civic Centre | 44 York Street | Twickenham | TW1 3BZ

☎: **020 8891 7364** | ✉: **andrea.kitzberger@richmond.gov.uk**

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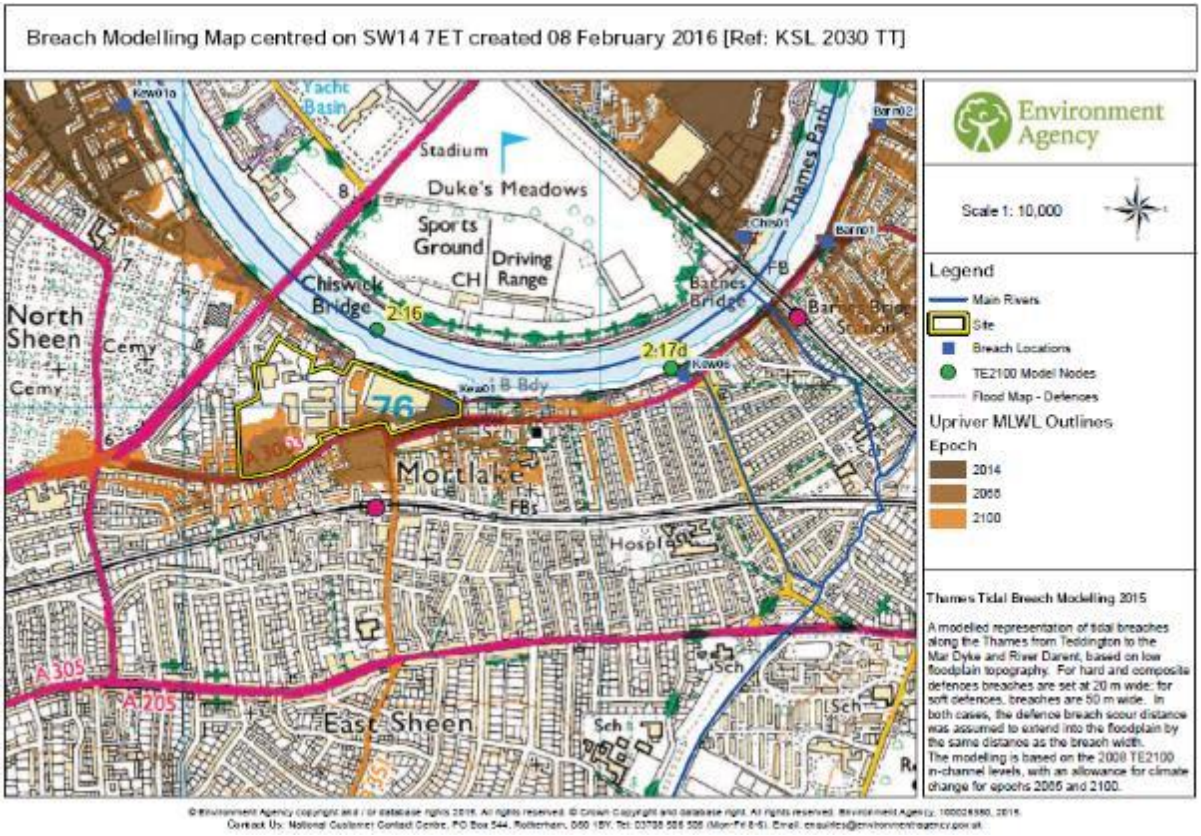
Appendix D Breach Analysis

D.1 Introduction

Breach analysis has already been undertaken by the Environment Agency for numerous locations along the tidal Thames. The results are presented for the site in Section 3.5 for a simulated breach of 20 m width at the location "Kew01" shown in Figure D-1. The breach would be within the Site east of Ship Lane and would represent a catastrophic failure of the existing tidal defence that is made up of the perimeter wall of this part of the site. The areas likely to be affected by the breach are also shown in Figure D-1 for 2014, 2055 and 2100. This is based on extreme water levels provided by the Environment Agency (i.e. without reference to specific values of probability). Further, these levels are those that result from three tidal cycles, after which it is assumed that some repair to the breach would have been effected.

Although breaching of defences is regarded as a "residual risk", the LBRuT indicated in their response to the Scoping Level FRA submitted in July 2016, that further modelling would be required. Specifically, this would seek to investigate the impacts of the proposed development on flood extents during a standard breach analysis. The findings are presented in this Appendix.

Figure D-1 Thames Tidal Breach Modelling



D.2 Modelling of the breach

The location of the breach at Kew01 is entirely within the Site – east of Ship Lane. The location would be along the section of wall shown in Figure D-2 and which would lead to inundation of the lower parts of the site. As part of the proposed development, the Site will be landscaped. Through this, ground levels adjacent to the defences will be raised to levels no lower than 6.03 mAOD – the peak TE2100 water level for 2100. Accordingly, there is effectively no risk of breach at this location – nor in fact at any location along the perimeter of this part of the site. The development of the Site therefore results in a reduced risk of breach with clear benefits for the surrounding area in reducing (residual) flood risk.

Figure D-2 Existing tidal defences (inset shows bricked up window)

In order that some effective breach analysis could be undertaken, it was assumed that a breach would occur at the stop-log arrangement at Bull's Alley, immediately to the east of the Site (Figure D-3 and C-4). The mechanism for removal of stop-logs is illustrated in Figure D-5. This stop-log arrangement enables maintenance vehicles to access the river to clear debris on the foreshore. Given this regular usage, it is anticipated that this location would be regularly inspected and maintained. The risk of breach is thus considered unlikely at this location.

A breach at this location would be much narrower than in the original Environment Agency modelling. A 6 m breach has been modelled. This in turn required that the model grid be reduced to from 5 m to 2.5 m in order that the breach could be reasonably represented in the model domain.

Figure D-3 Stop-logs at Bull's Alley (from river)

Figure D-4 Stop-Logs at Bull's Alley (towards river)

Figure D-5 Stop-logs at Bull's Alley – from above

D.3 Modelling results

The model supplied by the Environment Agency for the Lower Thames has been modified to reflect the breach at Bull's Alley. It has been run for the 2100 extreme water levels in a standard breach analysis.

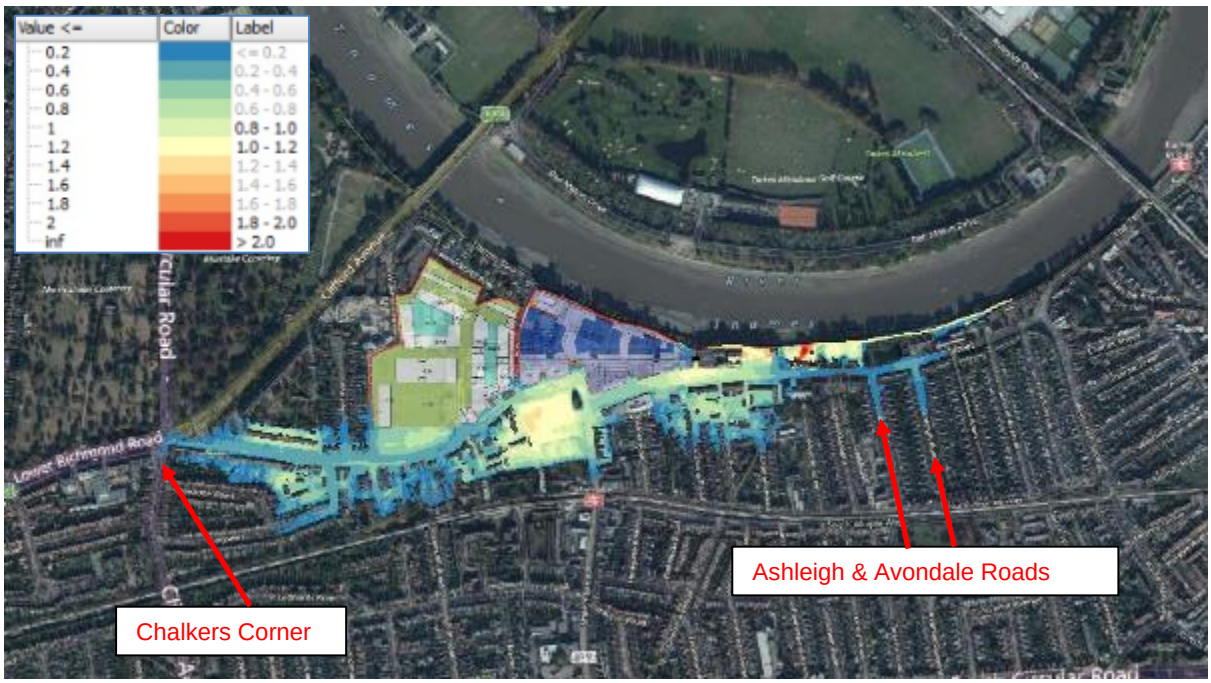
The original flood extents from the Environment Agency's model are shown in Figure D-6; these are for the 2100 levels, but for the baseline (i.e. existing site layout). The results obtained using the modified model (i.e. with the breach at Bull's Alley) and for the proposed layout are shown in Figure D-7. Finally, a comparison has been made in Figure D-8 by mapping the difference in depths across the domain.

The main observations from these Figures are as follows:

- The revised breach analysis shows a general reduction in the area affected by the breach;
- This reduction is most pronounced to the west of the site at the junction of Lower Richmond Road and Clifford Avenue at Chalkers Corner;
- There is also a reduced flood extent along Ashleigh and Avondale Roads to the east of the site;
- There is a corresponding reduction in flood depths across virtually the entire model domain;

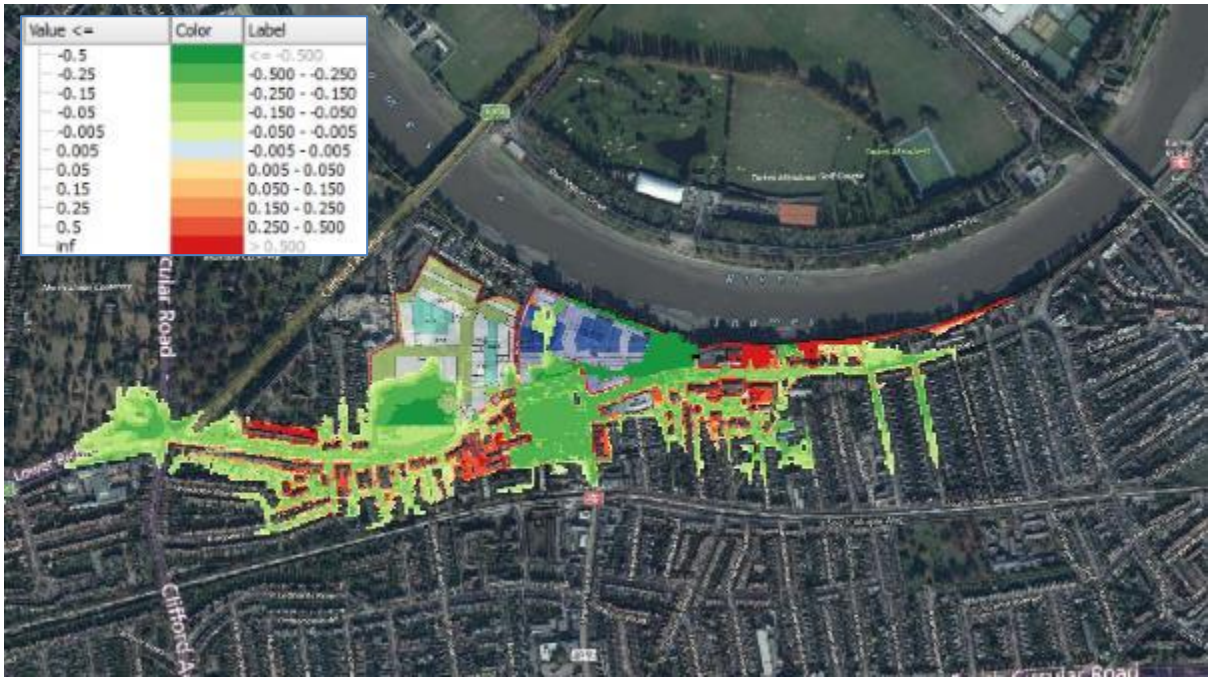
Figure D-6 Breach analysis – 2100 Baseline: EA model depths

Figure D-7 Breach analysis – 2100 Developed: HLS Model Depths (Bull's Alley Breach)



- There are localised increases, throughout the model domain; in places, these are of the order of 0.5 m. The locations showing an increase reflect the model assumptions that were required to model the breach at Bull's Alley. This required the use of a finer model grid size (2.5 m) than was used for the Environment Agency model (namely 5 m). The enhanced model has led to floodwater exploiting flow paths and areas that were not accessible in the model with the coarse grid. The areas where increases are shown are contiguous with areas showing a general reduction in flood depths. They are accordingly an artefact of the model rather than a cause for concern.

Figure D-8 Breach analysis – 2100 Baseline - Differences in depth



D.4 Summary

This Appendix describes the breach modelling that has been undertaken as part of the FRA. It has been undertaken following feedback from LBRuT and is required in order to assess the impact that the proposed development may have on flood extents resulting from breach analysis. The main findings are as follows:

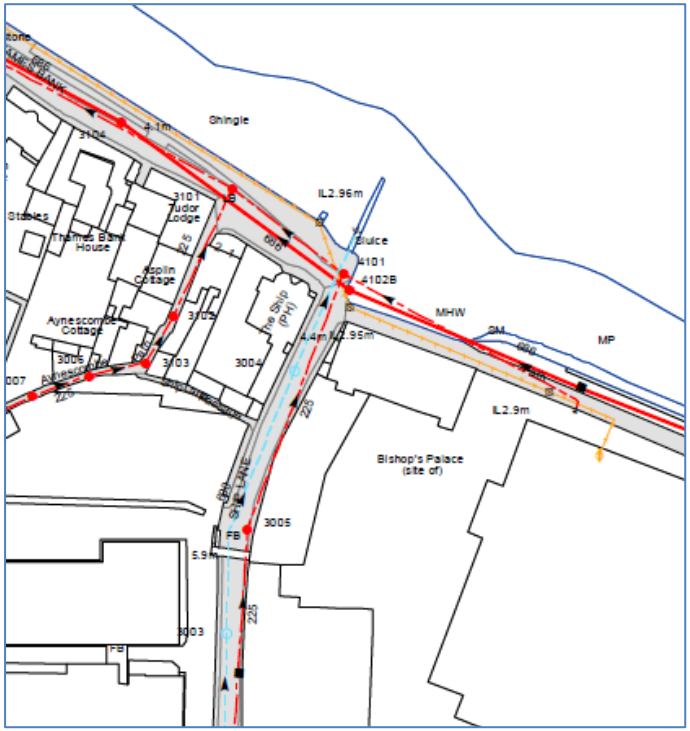
i. The risk of breach would be substantially reduced following the proposed development due to the significant upgrading of defences along the river frontage.
ii. Subsequent to development, the breach modelled by the Environment Agency with an arbitrary breach width of 20 m, could not occur due to the land raising. The most likely location for a breach would be at the stop-logs in Bull's Alley. At this point, the maximum width of breach is reduced to 6 m.
iii. The risk of a breach at this location is considered very small since the location is routinely inspected.
iv. Model runs have been undertaken to compare the flood extents resulting from a breach at Bull's Alley with those from Environment Agency modelling. These show a general reduction in flood levels and extents throughout the affected area. Whilst there are some localised increases, these are a consequence of the finer grid size used in the modelling of the breach at Bull's Alley for the developed case.

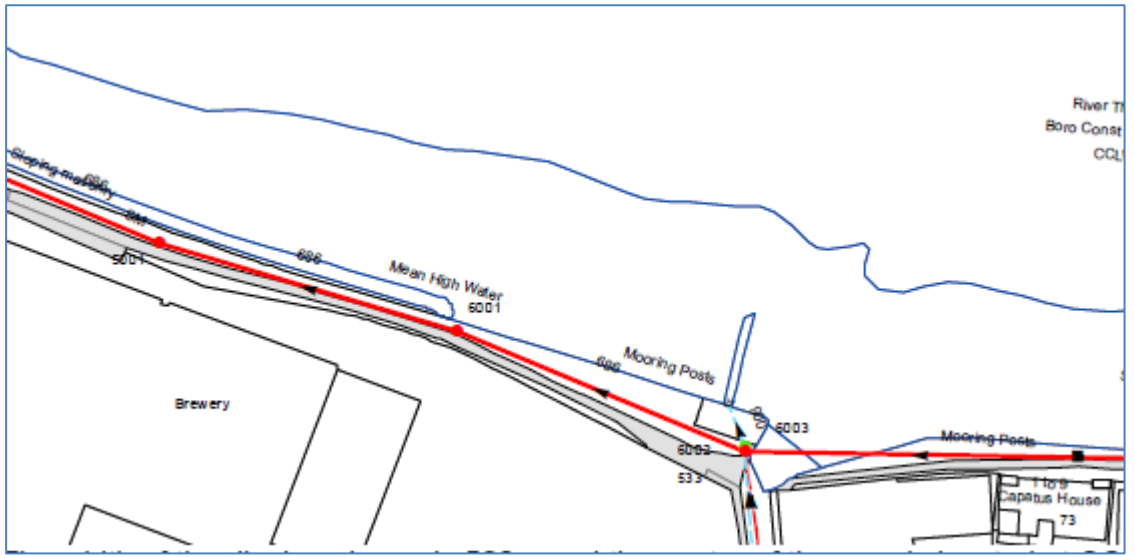
In summary, the proposed development is considered to result in a significant reduction in residual risk. This is partly due to the greater integrity of the defences, post development, and partly due to the smaller width and likely lower incidence of breach at the stop-logs in Bull's Alley. The modelling undertaken as part of this FRA has shown a general reduction in flood extent and depths compared with the Environment Agency modelling.

Appendix E Enquiry to Thames Water: Sewers

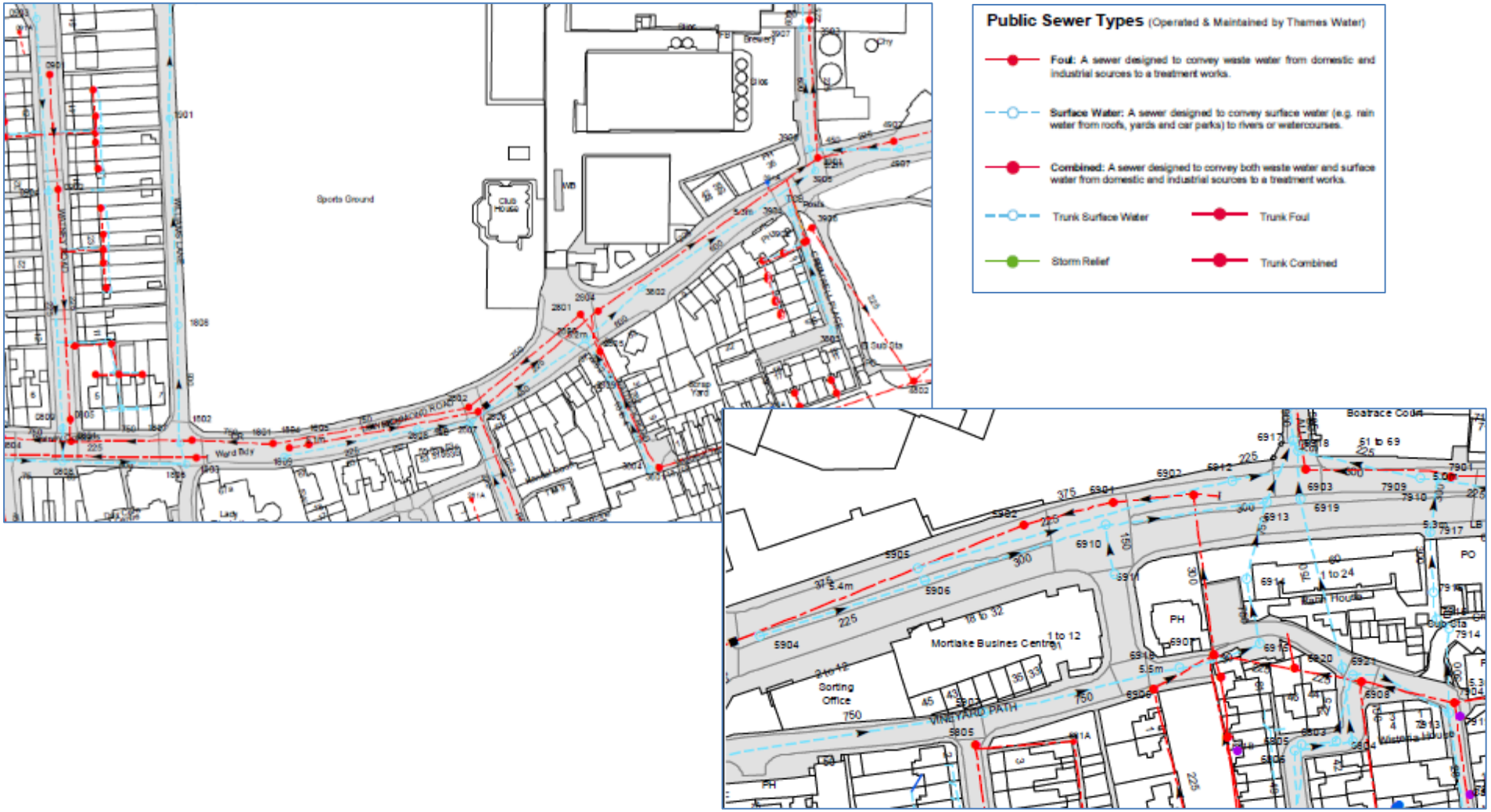
These are extracts from the Thames Water response to a developer enquiry by Waterman on 22 January 2016.

E.1 Northern part of site





E.2 Southern part of site



Appendix F Allowances for climate change in NPPF

F.1 Introduction

In February 2016, the Environment Agency updated the climate change allowances required in Flood Risk Assessments (Environment Agency, 2016); this advice updates previous climate change allowances to support NPPF (2012). Guidance has been provided for

- peak river flow by river basin district
- peak rainfall intensity
- sea level rise
- offshore wind speed and extreme wave height.

The general guidance is provided in this Appendix.
For flood risk assessments and strategic flood risk assessments, assess both the central and upper end allowances to understand the range of impact.

F.2 Peak River Flow Allowances

The peak river flow allowances for flood risk assessments should be applied by reference to the flood zone and vulnerability classification as shown below.

In flood zone 2:

- essential infrastructure – use the higher central and upper end to assess a range of allowances
- highly vulnerable – use the higher central and upper end to assess a range of allowances
- more vulnerable – use the central and higher central to assess a range of allowances
- less vulnerable – use the central allowance
- water compatible – use none of the allowances

In flood zone 3a

- essential infrastructure – use the upper end allowance
- highly vulnerable – development should not be permitted
- more vulnerable – use the higher central and upper end to assess a range of allowances
- less vulnerable – use the central and higher central to assess a range of allowances
- water compatible – use the central allowance

In flood zone 3b

- essential infrastructure – use the upper end allowance
- highly vulnerable – development should not be permitted
- more vulnerable – development should not be permitted
- less vulnerable – development should not be permitted
- water compatible – use the central allowance

If (exceptionally) development is considered appropriate when not in accordance with flood zone vulnerability categories, then it would be appropriate to use the upper end allowance.

Table F-1 Total Potential Change for River flow

River basin district	Allowance category	'2020s' (2015 - 2039)	'2050s' (2040 - 2069)	'2080s' (2070 - 2115)
Northumbria	Upper end	20%	30%	50%
	Higher central	15%	20%	25%
	Central	10%	15%	20%
Humber	Upper end	20%	30%	50%
	Higher central	15%	20%	30%
	Central	10%	15%	20%
Anglian	Upper end	25%	35%	65%
	Higher central	15%	20%	35%
	Central	10%	15%	25%
South East	Upper end	25%	50%	105%
	Higher central	15%	30%	45%
	Central	10%	20%	35%
Thames	Upper end	25%	35%	70%
	Higher central	15%	25%	35%
	Central	10%	15%	25%
South West	Upper end	25%	40%	85%
	Higher central	20%	30%	40%
	Central	10%	20%	30%
Severn	Upper end	25%	40%	70%
	Higher central	15%	25%	35%
	Central	10%	20%	25%
Dee	Upper end	20%	30%	45%
	Higher central	15%	20%	25%
	Central	10%	15%	20%
North West	Upper end	20%	35%	70%
	Higher central	20%	30%	35%
	Central	15%	25%	30%
Solway	Upper end	20%	30%	60%
	Higher central	15%	25%	30%
	Central	10%	20%	25%
Tweed	Upper end	20%	25%	45%
	Higher central	15%	20%	25%
	Central	10%	15%	20%

Table 1 peak river flow allowances by river basin district (use 1961 to 1990 baseline)

F.3 Peak Rainfall Intensity Allowances

For flood risk assessments and strategic flood risk assessments, both the central and upper end allowances should be used to understand the range of impact.

Table F-2 Peak rainfall intensity allowances

Applies across all of England	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2115)
Upper end	10%	20%	40%
Central	5%	10%	20%

Table 2 peak rainfall intensity allowance in small and urban catchments (use 1961 to 1990 baseline)

F.4 Sea Level Allowances

There is a single regional allowance for each epoch or time frame for sea level rise in the Table.

Table F-3 Sea level allowances

Area of England	1990 to 2025	2026 to 2055	2056 to 2085	2086 to 2115	Cum rise 1990 to 2115
East, east midlands, London, south east	4 (140 mm)	8.5 (255 mm)	12 (360 mm)	15 (450 mm)	1.21 m
South West	3.5 (122.5 mm)	8 (240 mm)	11.5 (345 mm)	14.5 (435 mm)	1.14 m
North west, north east	2.5 (87.5 mm)	7 (210 mm)	10 (300 mm)	13 (390 mm)	0.99 m

Table 3 sea level allowance for each epoch in millimetres (mm) per year with cumulative sea level rise for each epoch in brackets (use 1990 baseline)

F.5 Offshore wind speed and extreme wave height Allowances

Table F-4 Wind Speed and Wave Height Allowances

Applies around all the English coast	1990 to 2055	2056 to 2115
Offshore wind speed allowance	+5%	+10%
Offshore wind speed sensitivity test	+10%	+10%
Extreme wave height allowance	+5%	+10%
Extreme wave height sensitivity test	+10%	+10%

Table 4 offshore wind speed and extreme wave height allowance (use 1990 baseline)

Appendix G Flood Emergency Plan

G.1 Introduction

This is the Flood Emergency Plan for the Site. It has been prepared with help and guidance from the Environment Agency and LBRuT and informed by the Planning Advice Note for Guidance on Producing a Flood Emergency Plan (LBRuT, 2011).

G.2 General

G.2.1 Scope, Objectives and Background

The purpose of this document is to present the Plan for the proposed development. Its content is relevant to residents and users of the site in order that they understand both the risks of flooding and the actions that they will need to take to prepare for and to respond to flooding. The document is also relevant to the emergency services and LBRuT officials who will be required to manage the emergency response during flooding.

The objectives are:

- To inform residents of the risks of flooding.
- To outline proper and safe procedures to be followed before and during flooding.
- To explain the meanings of flood warnings and what action will be required and by whom.
- To provide clear advice on emergency procedures to be followed before and during a flood event.

The important aspects of this plan include:

- That the principal type of flooding that may affect the area is tidal flooding.
- That virtually the entire site, including the basement car parks, has been designed to be at a safe level throughout its planned life including an allowance for climate change. This also applies to the residual risk due to breach of the tidal defences.
- The main risks from flooding are on the towpath between the site boundary and the River Thames.
- In the unlikely event that evacuation is required, a safe (and dry) pedestrian route is available from the site to land wholly within flood zone 1.
- The emergency contacts.

G.2.2 Location and Proposal

Prior to its acquisition, the Site was an operational brewery. The proposed development involves demolition of existing buildings, land raising and construction of buildings as residential accommodation, as well as retail and educational provision, as described in Section 4.1.

The accompanying FRA has shown that virtually the entire site will be protected from flooding by setting the formation level for the site at, or above the reference flood level. The reference flood level has been agreed with the Environment Agency and the LBRuT and is at 6.03 mAOD and corresponds with the TE2100 design flood level for 2100. All new residential accommodation has been set a minimum of 1 m above the reference flood level (nominally at 7.03 mAOD), and so is at an acceptably low risk of flooding.

The FRA has also noted that the development proposal will lead to a slight reduction in the flood risk to surrounding properties. This is due to the following factors:

- A surface water management plan that will see a reduction of the peak rates of runoff from their current rates;
- Landscaping of the site that will see a general reduction in flood extents and depths following breach analysis, compared with the extents modelled by the Environment Agency in their breach analysis;
- The Basement Car park may lead to a minor blocking of groundwater flow paths from the River Thames that will afford some protection for basements to the south of the proposed development; and
- The availability of the site as a refuge for residents in adjacent properties in the event of overtopping or breach of the defences.

The most important issue for users of the proposed development to note is that it will be at an acceptably low risk from flooding. The principal risks to be faced by users of the site will likely be accessing the surrounding low-lying areas of the Thames towpath.

G.2.3 Risk Assessment Summary

This being a riverside site, with a generally open access to the river, the principal risk faced by residents will be that of the proximity to a tidal river. Whilst the site itself has an open outlook to the Thames, the boundary between the Site and the towpath is protected by railings and glass balustrade as shown in Figure 4-6. The riverside areas will be equipped with a range of safety signs and equipment, the precise location and type to be decided at detailed design stage (Section G.3.3.)

As noted above, there is a residual risk of flooding due to a breach of the tidal defences. The buildings that may be affected have been reviewed in detail in Section 4.2.3. With current flood levels, this residual risk is negligible. However, over the lifetime of the Scheme, this residual risk will increase.

G.2.4 Assessment of potential Mitigation Measures

The Site features the following mitigation measures:

- Self-Activating Flood Barrier for the entrance to the Basement Car Park from Mortlake High Street;
- Flood proof doors and/or demountable barriers for access from the Community Boathouse to the river foreshore.

There is a future requirement for tidal flood gate on Ship Lane, to ensure the integrity of the tidal defences. Without this gate, peak water levels would be able to propagate along Ship Lane. This will only be required at some point in the future. Accordingly, the description and the management procedure for the gate will likely be the subject of a suitably worded Planning Condition. However, a suitable location has already been earmarked in the scheme.

G.3 Flood Procedures

G.3.1 Lead times

The nature of the flood risk, being tidal, may be forecast with a high degree of accuracy of both the timing and the magnitude. These forecasts draw heavily on the Storm Tide Forecasting Service operated by the Met Office.

Although the tidal events may be predicted with confidence, the occurrence of breaches in the defences cannot be. The lead times associated with such breaches, should they be close to the site, is to all intents and purposes, zero. Warnings will thus be of no practical value.

G.3.2 Flood Warnings

The responsibility for issuing flood warnings in the tidal Thames lies with the Environment Agency. Their system for issuing warnings to the emergency services and to residents at risk of flooding via the Environment Agency's Floodline system, is well tested and effective.

It is not expected that any residents would need to sign up for flood warnings on account of the location of their residence being safe. Clearly, some people may wish to sign up the Floodline so as to be better appraised of flood risk in a particular area.

Those with responsibility for managing the towpath and the boat facilities should sign up to Floodline since they may need to issue warnings to users of these facilities.

G.3.3 Flood Notices & Equipment

Users of the towpath and the part of the site closest to the river will be at increased risk, especially at times of tidal flooding. It will be necessary to close the Riverside path during flooding. This will be explained to users of the path by appropriate notices. These would be deployed at the eastern end of the site (near Bull's Alley) and near Ship Lane. Furthermore, warning signs will be required within the development site where it provides access to the towpath.

G.3.4 Actions upon receiving Alerts and Warnings

(a) Residents

There is no need for residents to be in receipt of flood warnings. No action is thus required.

(b) Towpath/Boat House Managers

On receipt of warnings, managers should assess the need for and the timing of towpath closure and other facilities. The Environment Agency warnings for the tidal Thames are of good quality for both the reliability and the long lead time. It is thus most unlikely that managers would need to close paths "during" a day. In all likelihood, they could be closed at the beginning or end of a day to minimise any disruption.

Closure would be by the deployment of signage that highlighted the risk to users. Similar signage would be required within the site where it abuts the River.

The default position for flood proof doors/demountable barriers is that they will be closed and provide protection. However, Boat House Managers should check that the systems are correctly in place and able to operate effectively.

G.3.5 Safe Egress Procedures & Evacuation Routes

(a) Residents

As indicated above, the site has been designed to be safe from the effects of flooding. Accordingly, no evacuation of the site is anticipated. For completeness, a safe, pedestrian route has been identified that would enable residents to leave the site on foot, should they need to do this. This is detailed below in Section (c).

(b) Towpath and Boathouse facilities

The reliability of Environment Agency warnings coupled with the predictability of the tidal risk is such that the public facilities can be closed in advance of any imminent flood risk. There is, accordingly, no need for evacuation from the towpath or boat house. In any event, access is readily available to the Site where it abuts the River.

(c) The emergency access route

The emergency access route would only need to be used in the event of breach or widespread failure of the defences. Given the scale of landscaping with raised areas located behind tidal defences, any such breach may only occur at the eastern end of the site, in the vicinity of Bull's Alley.

As indicated in the previous Section, virtually the entire site, including residential accommodation and basement car parks have been designed to be safe from flooding. All residential property is set at a minimum of 7.3 mAOD. Furthermore, there is access from all residential blocks to land at a minimum of 6.03 mAOD, with the exception of The Maltings, where the exit form residential property is at 5.53 mAOD, which is addressed separately below. This ensures "dry" access within the site and in particular to a proposed exit point at the western end of the Site onto Williams Lane.

The exit from the Maltings at 5.53 mAOD is 0.50 m below the reference flood level (Figure 4-10). In practice, this may involve a walk through standing water to a depth of no more than 0.50 m. This leads to a Hazard Rating (Table G-1) of 1.25 ("Danger for Some"), or 0.25 ("Very Low Hazard") if one assumes no debris (debris factor = 0). In practical terms, it is difficult to see how water from a breach could enter this area. This assessment is thus highly precautionary.

Non-residential usage, where floor levels are below 6.03 mAOD have been reviewed in detail in Section 4.2.3 where there is a residual risk of flooding resulting from a breach of the tidal defences for the 2100 timescale. These buildings are shown in Figure 4-9 and include:

- B01 Cinema
- B04 Maltings – Flexible use space
- B05 Hotel lobby
- B06 Flexible use space
- B09 Community Boathouse – Boat storage and clubhouse facilities
- B10 Flexible use space

In each case, as shown in Section 4.2.3, there is safe access to areas that are above the reference flood level. In the September 2019 revised design, the Community Boathouse will be behind the formal Thames Flood Defences with no need for dedicated flood protection systems.

Table G-1 Hazard to People Classification System

Flood Hazard Rating (HR)	Colour Code	Hazard to People Classification	Use of flood emergency plans to manage flood risk
Less than 0.75		Very low hazard – caution	Acceptable
0.75 to 1.25		Danger for some – includes children, the elderly and the infirm	Maybe acceptable
1.25 to 2.0		Danger for most – includes the general public	Unlikely to be acceptable
More than 2.0		Danger for all – includes the emergency services	Unacceptable

HR	Depth of flooding - d (m)												
	DF = 0.5				DF = 1								
Velocity - v (m/s)	0.05	0.10	0.20	0.25	0.30	0.40	0.50	0.60	0.80	1.00	1.50	2.00	2.50
0.0	0.03 + 0.5 = 0.53	0.05 + 0.5 = 0.55	0.10 + 0.5 = 0.60	0.13 + 0.5 = 0.63	0.15 + 1.0 = 1.15	0.20 + 1.0 = 1.20	0.25 + 1.0 = 1.25	0.30 + 1.0 = 1.30	0.40 + 1.0 = 1.40	0.50 + 1.0 = 1.50	0.75 + 1.0 = 1.75	1.00 + 1.0 = 2.00	1.25 + 1.0 = 2.25
0.1	0.03 + 0.5 = 0.53	0.06 + 0.5 = 0.56	0.12 + 0.5 = 0.62	0.15 + 0.5 = 0.65	0.18 + 1.0 = 1.18	0.24 + 1.0 = 1.24	0.30 + 1.0 = 1.30	0.36 + 1.0 = 1.36	0.48 + 1.0 = 1.48	0.60 + 1.0 = 1.60	0.90 + 1.0 = 1.90	1.20 + 1.0 = 2.20	1.50 + 1.0 = 2.55
0.3	0.04 + 0.5 = 0.54	0.08 + 0.5 = 0.58	0.15 + 0.5 = 0.65	0.19 + 0.5 = 0.69	0.23 + 1.0 = 1.23	0.30 + 1.0 = 1.30	0.38 + 1.0 = 1.38	0.45 + 1.0 = 1.45	0.60 + 1.0 = 1.60	0.75 + 1.0 = 1.75	1.13 + 1.0 = 2.13	1.50 + 1.0 = 2.50	1.88 + 1.0 = 2.88
0.5	0.05 + 0.5 = 0.55	0.10 + 0.5 = 0.60	0.20 + 0.5 = 0.70	0.25 + 0.5 = 0.75	0.30 + 1.0 = 1.30	0.40 + 1.0 = 1.40	0.50 + 1.0 = 1.50	0.60 + 1.0 = 1.60	0.80 + 1.0 = 1.80	1.00 + 1.0 = 2.00	1.50 + 1.0 = 2.50	2.00 + 1.0 = 3.00	2.50 + 1.0 = 3.50

The offsite access route is shown in Figure G-2 by a solid red-line. This route is above the reference flood level of 6.03 mAOD and leads to the A316 (Clifford Avenue), an elevated road.

Access would then normally be in a south-westerly direction, along Clifford Avenue towards Chalkers Corner. Chalkers Corner is shown to be in the area affected by a breach in 2100 conditions according to the latest Environment Agency modelling (Figure 3-22b). However, modelling undertaken in support of this FRA and described in Appendix D has shown that following the development of the Site and with a breach location at Bull's Alley, a breach for 2100 conditions would not affect this junction.

In any case, should that route prove to be affected by a breach, then there exists an alternative route to the north-east along Clifford Avenue. This would lead over the River Thames to the Great Chertsey Road on the north bank.

Figure G-1 On-site Access Route

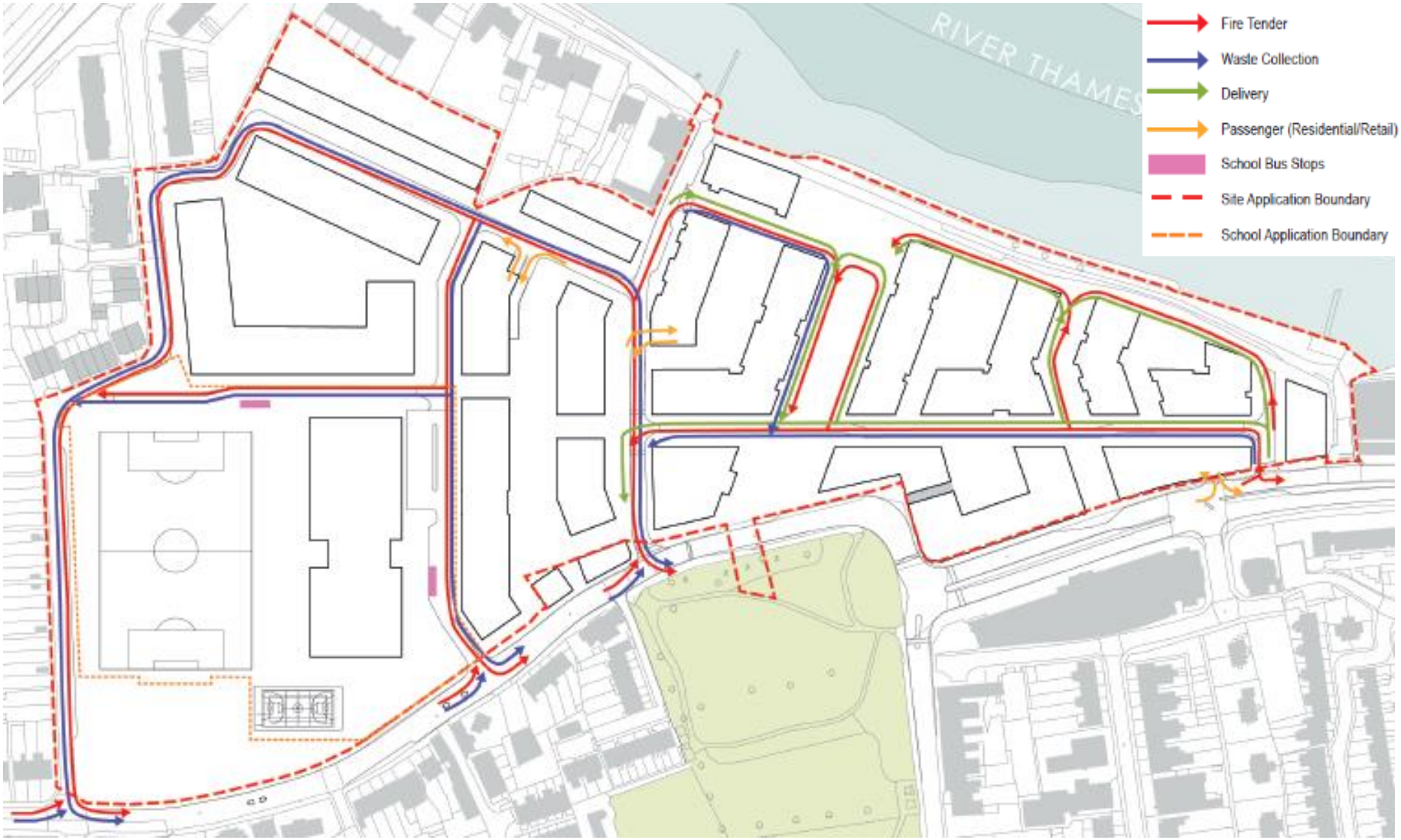


Figure G-2 Off-site Access Route

G.3.6 On-Site and/or Temporary Refuge

The site will provide a permanent refuge from flooding as it has been designed to be at a safe level. It can continue to be fully operational for the benefit of residents. Significantly, it would be available as a refuge for residents of adjacent properties, should they be affected by flooding.

G.3.7 Actions Post-Evacuation & Post Flood

It is not envisaged that the site would be evacuated, so this Section refers to actions following flooding of the towpath and possibly of the Boathouse. Prior to reopening the facilities, managers should verify that the towpath is safe to use. This may involve clearance of debris and minor repairs, where some erosion may have occurred. Should more substantial repairs be required, then the period of closure may need to be extended until such time as the repairs have been completed. The flood proof doors for the Boathouse should be checked for any signs of damage, with replacements sought if required.

G.3.8 Dangers of Flood Water

The proximity of the site to the River Thames means that residents should have some appreciation of the presence of water and associated hazard. This will be reinforced by warning notices at various locations and the provision of appropriate rescue equipment. Warnings should address not only the risk of drowning but also the risk of contact with contaminated flood water and the dangers of underwater obstacles. Such notices should be available for every property as part of the “residents’ welcome pack”.

G.4 Management of the Flood Emergency Plan

This is a relatively simple plan and it is not expected that it would require much updating. However, some review may be warranted following flood events under the guidance of overall site managers.

G.4.1 Business Continuity Plans

The fact that the site has been designed to be safe from flooding means that Business Continuity is not an issue due to flooding, other than in relation to the activities on the towpath and the Boathouse.

Off-site flooding may occur following a breach. This may have a minor impact on business; however, any interruptions are likely to be episodic and of a few hours’ duration, consistent with the tidal cycle.

G.4.2 List of Key Contacts

A list of key contacts is given in Table G-2.

G.4.3 Plan Usage and Dissemination

The key actions that are required include:

- Provide all residents with a statement relating to flood risk. This will highlight the way that the site has been designed to be safe from flooding. This may be required by Insurers.

- The Emergency Plan would need to be retained by Site Managers and the managers of the towpath and boathouse facilities.
- Full information will also be available via the internet on warnings and actions.

G.4.4 Document Control and Monitoring

This Emergency Plan has been prepared for the scheme as envisaged at the time of Planning Application. The Plan should be updated to reflect the Scheme "as built" and to refine it so that it is suitable for a non-technical readership.

The procedure for updating this plan has been described above. The document would be "owned" by the Site Management staff, who would apply relevant control procedures to ensure key changes were communicated to all residents and updated on the web site, as required.

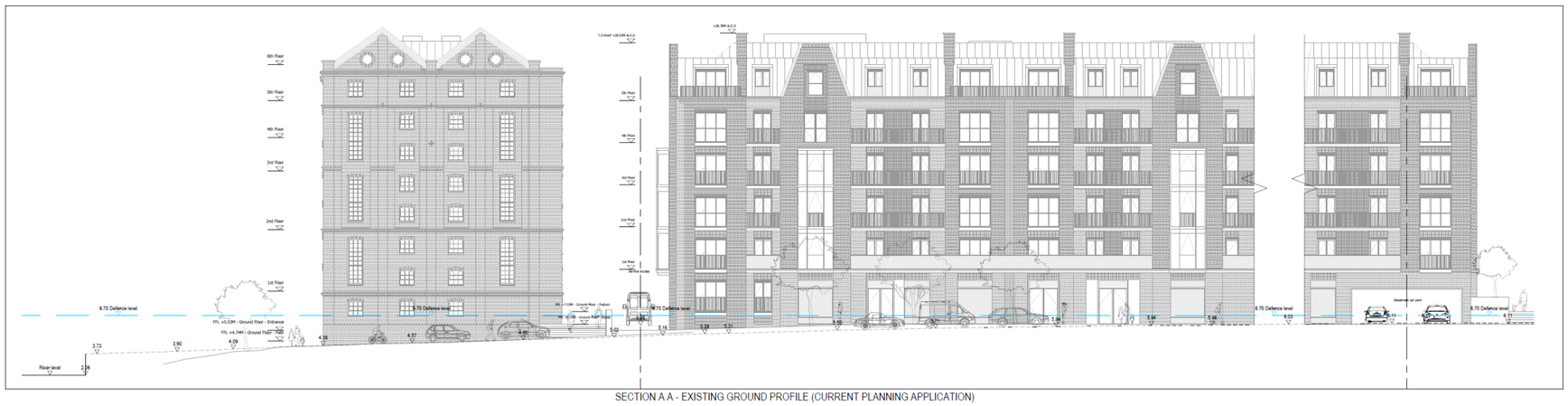
Table G-2 List of key Contacts

Organisation	**Service**	**Name/number**
Site office		To be advised
Environment Agency	Advice, warnings	Floodline number = 0345 988 1188
Environment Agency	Advice, warnings	http://www.environment-agency.gov.uk/default.aspx
LBRuT	Council services	08456 122 660
LBRuT	Emergency out of hours	020 8744 2442
Thames Valley Police	Non-emergency enquiries	101
Thames Water	24 hour service	0845 7200 898
Energy	Various	http://www.energynetworks.org/ Gives contacts for all energy companies

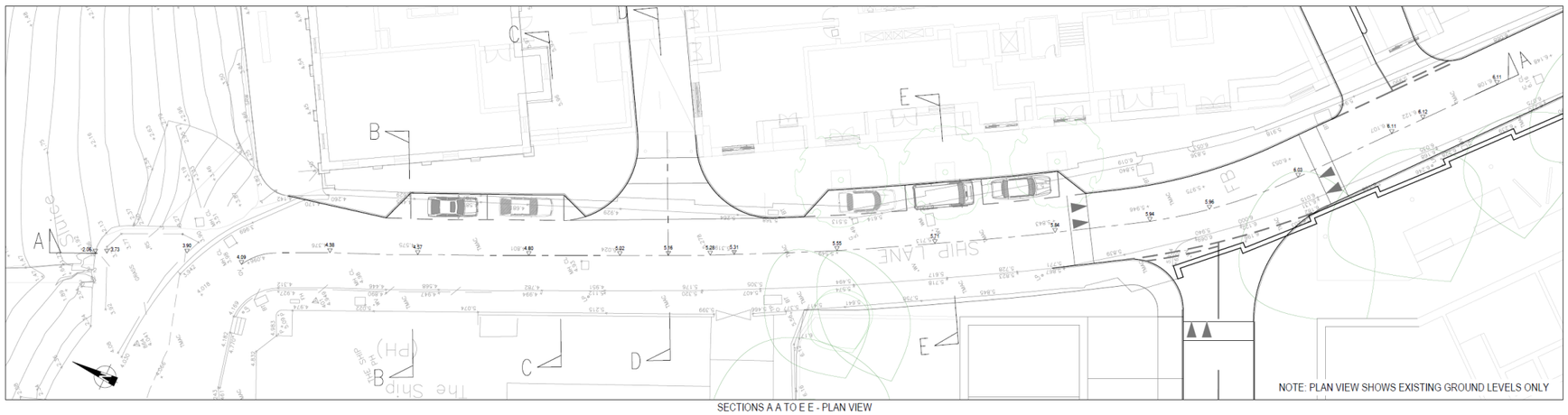
Appendix H Proposed Defences for Ship Lane

"STAG BREWERY, MORTLAKE: SHIP LANE, POSSIBLE GROUND PROFILES FOR FLOOD DEFENCE MEASURES" Reference 38262/5501/097 A and Reference 38262/5501/098 A (dated 7th January 2019)

SECTION A A - FUTURE GROUND PROFILE (1:12 SLOPE)



SECTION A A - EXISTING GROUND PROFILE (CURRENT PLANNING APPLICATION)



SECTIONS A A TO E E - PLAN VIEW

Mark	Revision	Date	Drawn	Chkd	Appd
A	Labelling revised	07.01.19	REM	MB	MB

DO NOT SCALE NOTE: Do not scale from this drawing. If in doubt, ask.
UTILITIES NOTE: The position of any existing public or private sewers, utility services, plant or apparatus shown on this drawing is believed to be correct, but no warranty to this is expressed or implied. Other such plant or apparatus may also be present but not shown. The Contractor is therefore advised to undertake their own investigation where the presence of any existing sewers, services, plant or apparatus may affect their operations.

Drawing Issue Status
FOR INFORMATION

STAG BREWERY, MORTLAKE
SHIP LANE
POSSIBLE GROUND PROFILES FOR
FLOOD DEFENCE MEASURES (SHEET 1 OF 2)

Client
RESELTON PROPERTIES

Date of 1st issue	Designed	Drawn
20.12.2018	REM	REM
A2 Scale	**Checked**	**Approved**
1:125	RAP	RAP
Drawing Number		**Revision**
38262/5501/097		A

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SHIP LANE
SECTIONS A A TO E E - PLAN VIEW
SECTION B B - FUTURE
SECTION C C - FUTURE
SECTION D D - FUTURE
SECTION E E - FUTURE
SECTION B B - EXISTING GROUND
SECTION C C - EXISTING GROUND
SECTION D D - EXISTING GROUND
SECTION E E - EXISTING GROUND
The Ship Inn
Proposed parking bay
6.70 Defence level
Proposed ramp for service vehicles
Proposed residential
Proposed basement car park
Existing guard rail & raised walkway
A Labelling revised 07.01.19 REM MB MB
Mark Revision Date Drawn Chkd Appd
FOR INFORMATION
STAG BREWERY, MORTLAKE
SHIP LANE
POSSIBLE GROUND PROFILES FOR
FLOOD DEFENCE MEASURES (SHEET 2 OF 2)
Client
RESELTON
PROPERTIES
pba peterbrett
now part of
Stantec
20.12.2018
1:125
38262/5501/098
A

Appendix I Environment Agency Response on River Wall and Flood Defences

creating a better place

Environment Agency

Ms Lucy Thatcher
London Borough of Richmond upon Thames
Planning Department
Civic Centre (44) York Street
Twickenham
Middlesex
TW1 3BZ

Our ref: SL/2018/118128/06-L01
Your ref: 18/0547/FUL

Date: 8 October 2019

Dear Ms Thatcher

APPLICATION A: Hybrid application to include 1. The demolition of existing buildings and structures, except The Maltings and the façade of the Bottling Plant and former Hotel; Site clearance and groundworks, to allow for the comprehensive phased redevelopment of the site: 2. Detailed application for works to the east side of Ship Lane which comprise: a. Alterations and extensions to existing buildings; erection of buildings (3 to 8 storeys) plus basements to allow for 443 residential apartments; Flexible use floorspace for various commercial uses, community and leisure; and hotel, cinema, gym and office floorspace b. New pedestrian, vehicle and cycle accesses and associated highway works c. Provision of on-site cycle, vehicle and service parking at surface and basement level d. Provision of public open space, amenity and play space and landscaping e. Flood defence and towpath works f. Installation of plant and energy centres 3. Outline application, with all matters reserved for works to the west of Ship Lane which comprise: a) Single storey basement and buildings varying in height from 3 to 7 storeys b) Residential development of up to 224 units c) Nursing and care home (up to 80 ensuite rooms) with associated facilities d) Up to 150 units of flexible use living accommodation for either assisted living or residential use e) New pedestrian, vehicle and cycle accesses and internal routes, and associated highway works f) Provision of on-site cycle, vehicle and service parking g) Provision of public open space, amenity and play space and landscaping.

The Stag Brewery, Lower Richmond Road, Mortlake, London.

We have reviewed the latest information including the River Wall Liaison Summary Note, dated 7th August 2019, ref: WIE15582-106-BN-1-2-1-EA submitted by the applicant and are now in the position to **remove our objection**.

The latest inform has demonstrated that the proposed development will meet the requirements of the Thames Estuary 2100 Plan and demonstrated that the development will not be at risk of flooding. The latest information submitted has shown that the proposed development will:

- raise all the window sills on the Maltings Building to 6.7 m AOD, above the current statutory defence level,
- positioned all entrances and windows riverward of the flood defence line on Ship Lane above the current statutory flood defence level of 5.94m,
- chosen to use the ground raisings shown in drawing '38262/5501/097 Rev A', so their flood defences tie in passively with flood defences to the west of their development,
- confirmed in an email sent on the 17th September 2019 that they will not be installing the flood gate shown in drawings P10736-00-001-116, 38262/5501/091 Rev D and

Environment Agency
3rd Floor, Seacole Building, 2 Marsham Street, London, SW1P 4DF
Telephone: 03708 506 506
Email: enquiries@environment-agency.gov.uk
Website: www.gov.uk/environment-agency

38262/5501/062 Rev K, and that this design has been superseded by the arrangement shown in drawings 38262/5501/097 Rev A and 38262/5501/098 Rev A.

The proposed development will only meet the requirements of the National Planning Policy Framework if the following measures as detailed in the Flood Risk Assessment and other technical documents submitted with this application are implemented and secured by way of the planning conditions set out in section one below on any planning permission.

Informative
It should also be noted that, as the proposed works are within 16m of a tidal flood defence, a flood risk activity permit would be required before works could proceed. For further guidance on permits and exemptions please visit our website at www.gov.uk/guidance/flood-risk-activities-environmental-permits or call our National Customer Contact Centre (NCCC) 03708 506 506.

Decision notice request
The Environment Agency requires decision notice details for this planning application in order to report on our effectiveness in influencing the planning process.Please email kslplanning@environment-agency.gov.uk with any decision notice details.

If you have any questions, please contact me.

Yours sincerely

Joe Martyn
Planning Specialist

Direct dial 020 3025 5546
Direct e-mail kslplanning@environment-agency.gov.uk

cc Gerald Eve LLP

Environment Agency
3rd Floor, Seacole Building, 2 Marsham Street, London, SW1P 4DF
Telephone: 03708 506 506
Email: enquiries@environment-agency.gov.uk
Website: www.gov.uk/environment-agency

Section 1: Conditions

Condition 1
The development permitted by this planning permission shall be carried out in accordance with the approved Flood Risk Assessment (FRA) by Waterman Infrastructure & Environment Ltd (February 2018 / WIE10667-101-R.10.6.1.1-Flood Risk) and associated documentation. The following mitigation measures detailed within shall be implemented:

1. finished floor levels for residential accommodation shall be set no lower than 7.03 metres above Ordnance Datum (mAOD);
2. no sleeping accommodation shall be located in the basement;
3. safe access and egress for the site shall be ensured;
4. all flood resilience measures shall be correctly implemented;
5. the areas shaded red in drawing G200_B09_P_00_002 Rev L are to be filled with an impermeable fill of either mass concrete, with the voids pre-lined with an impermeable membrane, or compressed clay-rich low-permeability soil;
6. the development's flood defence line along Ship Alley will passively tie in with the adjacent flood defences through the ground raising shown in drawing 38262/5501/097 Rev A;
7. with the exception of the Bulls Alley flood gate, no active flood defences shall be included within the development's flood defence line.

The mitigation measures shall be fully implemented prior to occupation and subsequently in accordance with the timing / phasing arrangements embodied within the scheme, or within any other period as may subsequently be agreed, in writing, by the local planning authority.

Reason
To reduce the risk of flooding to the development and occupants.

Condition 2
The development hereby permitted must not be commenced until such time as a scheme to ensure inspection and maintenance of existing flood defences has been submitted to, and approved in writing by, the local planning authority. The scheme will include details a suitable inspection and maintenance access scheme with the Environment Agency for the flood defences that run through the Boat Club building.

The scheme shall be fully implemented and subsequently maintained, in accordance with the scheme's timing/phasing arrangements, or within any other period as may subsequently be agreed, in writing, by the local planning authority.

Reason
This is to ensure the Environment Agency asset inspectors can safely inspect the flood defence in the confined space below the Boat Club terraces shown in drawing G200_B09_P_00_002 Rev L. To ensure the structural integrity of the existing and proposed flood defences thereby reducing the risk of flooding.

Potential Contamination
We have reviewed the document 'Preliminary Environmental Risk Assessment' (PERA) by Waterman (reference WIE10667-101-R-3-3-1 dated February 2018). The report has indicated the potential for ground contamination to be present and has recommended an intrusive investigation to assess this.

Environment Agency
3rd Floor, Seacole Building, 2 Marsham Street, London, SW1P 4DF
Telephone: 03708 506 506
Email: enquiries@environment-agency.gov.uk
Website: www.gov.uk/environment-agency

Condition 3
Prior to the commencement of development approved by this planning permission (or such other date or stage in development as may be agreed in writing with the Local Planning Authority), the following components of a scheme to deal with the risks associated with contamination of the site shall each be submitted to and approved, in writing, by the local planning authority:

1) A site investigation scheme, based on the PERA, to provide information for a detailed assessment of the risk to all receptors that may be affected, including those off site.
2) 2) The results of the site investigation and detailed risk assessment referred to in (1) and, based on these, an options appraisal and remediation strategy giving full details of the remediation measures required and how they are to be undertaken.
3) 3) A verification plan providing details of the data that will be collected in order to demonstrate that the works set out in the remediation strategy in (2) are complete and identifying any requirements for longer-term monitoring of pollutant linkages, maintenance and arrangements for contingency action. Any changes to these components require the express consent of the local planning authority. The scheme shall be implemented as approved.

Reason
For the protection of Controlled Waters. The site is located over a Secondary Aquifer and adjacent to the River Thames and it is understood that the site may be affected by historic contamination.

Condition 4
If, during development, contamination not previously identified is found to be present at the site then no further development (unless otherwise agreed in writing with the Local Planning Authority) shall be carried out until the developer has submitted, and obtained written approval from the Local Planning Authority for, a remediation strategy detailing how this unsuspected contamination shall be dealt with. The remediation strategy shall be implemented as approved, verified and reported to the satisfaction of the Local Planning Authority.

Reason
There is always the potential for unexpected contamination to be identified during development groundworks. We should be consulted should any contamination be identified that could present an unacceptable risk to Controlled Waters.

Condition 5
Prior to occupation of the development, a verification report demonstrating completion of the works set out in the approved remediation strategy and the effectiveness of the remediation shall be submitted to and approved, in writing, by the local planning authority. The report shall include results of sampling and monitoring carried out in accordance with the approved verification plan to demonstrate that the site remediation criteria have been met. It shall also include any plan (a "long-term monitoring and maintenance plan") for longer-term monitoring of pollutant linkages, maintenance and arrangements for contingency action, as identified in the verification plan, if appropriate, and for the reporting of this to the local planning authority. Any long-term monitoring and maintenance plan shall be implemented as approved.

Reason
Should remediation be deemed necessary, the applicant should demonstrate that any remedial measures have been undertaken as agreed and the environmental risks have been satisfactorily managed so that the site is deemed suitable for use.

Environment Agency
3rd Floor, Seacole Building, 2 Marsham Street, London, SW1P 4DF
Telephone: 03708 506 506
Email: enquiries@environment-agency.gov.uk
Website: www.gov.uk/environment-agency

Condition 6
Whilst the principles and installation of sustainable drainage schemes are to be encouraged, no drainage systems for the infiltration of surface water drainage into the ground are permitted other than with the express written consent of the Local Planning Authority, which may be given for those parts of the site where it has been demonstrated that there is no resultant unacceptable risk to Controlled Waters. The development shall be carried out in accordance with the approval details.

Reason
Infiltrating water has the potential to cause remobilisation of contaminants present in shallow soil/made ground which could ultimately cause pollution of groundwater.

Condition 7
Piling or any other foundation designs using penetrative methods shall not be permitted other than with the express written consent of the Local Planning Authority, which may be given for those parts of the site where it has been demonstrated that there is no resultant unacceptable risk to groundwater. The development shall be carried out in accordance with the approved details.

Reason
The developer should be aware of the potential risks associated with the use of piling where contamination is an issue. Piling or other penetrative methods of foundation design on contaminated sites can potentially result in unacceptable risks to underlying groundwaters. We recommend that where soil contamination is present, a risk assessment is carried out in accordance with our guidance 'Piling into Contaminated Sites'. We will not permit piling activities on parts of a site where an unacceptable risk is posed to Controlled Waters.

Condition 8
No development shall take place until a landscape and ecological management plan, including long-term design objectives, management responsibilities and maintenance schedules for all landscaped areas (except privately owned domestic gardens), has been submitted to, and approved in writing by, the local planning authority. The landscape and ecological management plan shall be carried out as approved and any subsequent variations shall be agreed in writing by the local planning authority.

The scheme shall include the following elements:

- details of maintenance regimes
- details of any new habitat created on-site
- details of treatment of site boundaries and/or buffers around water bodies
- details of management responsibilities

Reason
To ensure the protection of wildlife and supporting habitat. We support a site wide biodiversity strategy to be conditioned incorporating Biodiverse roofs, Native planting Bat/Bird boxes and other enhancements as advised in Appendix 11.1 Preliminary Environmental Risk Assessment.

Environment Agency
3rd Floor, Seacole Building, 2 Marsham Street, London, SW1P 4DF
Telephone: 03708 506 506
Email: enquiries@environment-agency.gov.uk
Website: www.gov.uk/environment-agency

Offices at

Bromyard

Clevedon

Exeter

Reading

Sheffield

Stirling

Registered office

Hydro-Logic Services (International) Ltd
Shearwater House,
Clevedon Hall Estate,
Victoria Road,
Clevedon,
BS21 7RD

Registered in England 03036787