

TFL_PSF_9131 SITE INVESTIGATIONS: SMALL SITES INITIATIVE WAPPING WHARF, TOWER HAMLETS, E1W 3NJ

Flood Risk Review

OCTOBER 2018



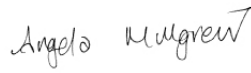
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Wapping Wharf, Tower Hamlets, E1W 3NJ

Flood Risk Review

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1 INTRODUCTION

1.1 Background

Arcadis Consulting (UK) Limited ('Arcadis') has been commissioned by Transport for London (TfL) 'the Client' to undertake technical surveys for a site known as Wapping Wharf, located north of Wapping High Street in the London Borough of Tower Hamlets ('the Site').

TfL is aiming to divest a number of small sites to enable positive regeneration. The objective of the Small Sites Initiative is to provide robust and pragmatic advice that sensibly de-risks each of the sites such that unreasonable 'abnormal' development costs are not included by developers.

The aim of this flood risk review is to assess the flood risk status of the Site and confirm the suitability for various forms of development on the Site, based on the findings of this desk study.

1.2 Scope of Works

Specific objectives of the flood risk review are to:

- Collect and review Environment Agency (EA) and Lead Local Flood Authority (Tower Hamlets London Borough Council (THLBC)) flood maps and published datasets (including Strategic Flood Risk Assessments, Preliminary Flood Risk Assessment and Local Flood Risk Management Strategy);
- Assess flood risk from all relevant sources (coastal and tidal, rivers, groundwater, surface water, sewers and artificial sources) and assign a risk value for each form of flooding (high, medium or low);
- Confirm the EA Flood Zone and confirm the acceptability of accommodating residential or other forms of development in accordance with the National Planning Policy Framework (NPPF) requirements;
- Confirm the need for application of the NPPF Sequential and Exception Tests; and
- Provide recommendations for further study or necessary flood risk mitigation measures to facilitate development.

1.3 Terminology

Flood risk is a produce of both the likelihood and consequence of flooding. Throughout this report, flood events are defined according to their likelihood of occurrence, Floods are described according to an 'annual chance', meaning the chance of a particular flood occurring in any once year. This is directly linked to the probability of a flood. For example, a flood with an annual chance of 1 in 100 (a 1 in 100 chance of occurring in any one ear on average), has an annual exceedance probability (AEP) of 1%.

1.4 Limitations

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This report has been compiled from several sources, which Arcadis believes to be trustworthy. However, Arcadis is unable to guarantee the accuracy of information provided by others. The report is based on information available at the time. Consequently, there is a potential for further information to become available, which may change this report's conclusion and for which Arcadis cannot be responsible.

2 SITE OVERVIEW

2.1 Site Description

The Site is located to the north of Wapping High Street in a generally urban setting, surrounded by residential, commercial and public buildings as well as public open spaces. The Site consists of three separate plots (Sites A, B and C), with a combined area of 0.25 hectares. The three plots are described below and shown in Figure 1.

Site A covers 0.17 hectares, centred at National Grid reference (NGR) 535000 180220. Land use consists of hardstanding and a former warehouse building that has fallen into disrepair. The site is bound by Cinnamon Street to the north, Clave Street and warehouses to the east, Wapping High Street to the south and residential properties to the west.

Site B occupies a corner site at the junction of Cinnamon Street and Clegg Street and is currently occupied by a single storey warehouse and a two storey annex building, both of which are vacant. The site covers 0.05 hectares and is centred at NGR 534975 180260.

Site C fronts Clegg Street and is occupied by a single storey warehouse and a residential flat. The site covers 0.03 hectares and is centred at NGR 535000 180280.



Figure 1: Site Location. Site Boundaries Outlined in Red
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2.2 Site Topography

Topographical information for the Site has been identified from EA Opensource Government License 2m LiDAR digital terrain mapping (DTM) datasets (Ref. 1). The Site is generally flat, with ground levels between 2.6m above ordnance datum (mAOD) and 4.6mAOD. The landform in the wider area is also generally flat, with elevations between 2.2mAOD and 6.6mAOD (Figure 2), rising towards the south and east.

An open air-vent is located in the centre of Site A, with an area of 13m by 13m and extending to a depth of 13.5m below ordnance datum. The air-vent serves the local TfL underground trainline.

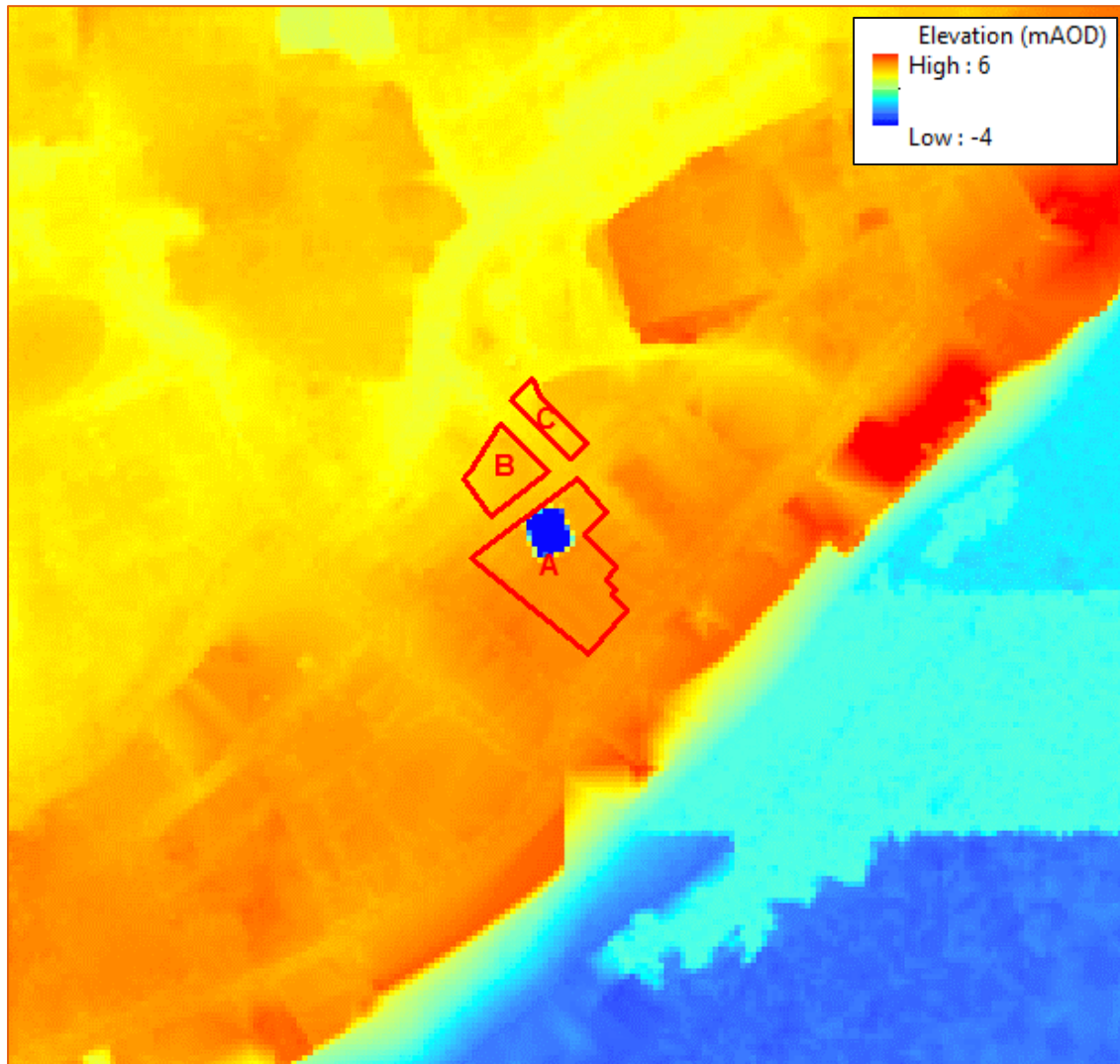


Figure 2: Site Topography. Site Boundaries Outlined in Red
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2.3 Catchment Description

The Site is located within the catchment of the River Thames, an EA designated Main River. The River Thames is located less than 100m southeast of Site A. To this point, the River Thames drains a catchment of over 10,000km² (Ref. 2). The River Thames is also tidally dominated at this point, with the tidal limit located at Teddington, approximately 33km upstream of the Site.

2.4 Ground Conditions and Aquifers

Soils underlying the Site are described as loamy and clayey soils of coastal flats with naturally high groundwater (Ref. 3).

The superficial geology consists of Alluvium – clay, silt, sand and peat (Ref. 4). The superficial geology supports a Secondary (undifferentiated) aquifer (Ref. 5). Such aquifers are defined by rock layers or drift deposits with a wide range of permeability and storage, which have previously been designated as both minor and non-aquifer.

The bedrock geology consists of the Lambeth Group – clay, silt and sand. The bedrock geology supports a Secondary A aquifer. This designation is defined by rock layers or drift deposits that are capable of supporting water supplies at a local, rather than strategic, scale and in some cases form an important source of baseflow to rivers.

3 DATA SOURCES

Information has been drawn from the web-based and published sources outlined below, as well as having been collected through consultation with the EA who provided Flood Product 4 and Flood Product 8 data packs (Ref. 6) (See Appendix A).

Web-based sources:

- Flood Estimation Handbook (FEH) Web-Service (Ref. 2);
- EA Long Term Flood Risk, Interactive Maps (Ref. 7);
- EA Flood Map for Planning (Ref. 8);
- Cranfield Soil and AgriFood Institute, Soilsclapes Viewer (Ref. 3); and
- British Geological Survey, Geology of Britain Viewer (Ref. 4).

Published documents:

- THLBC Level 2 Strategic Flood Risk Assessment (SFRA) (Ref. 9);
- THLBC Preliminary Flood Risk Assessment (PFRA) (Ref. 10);
- THLBC Local Flood Risk Management Strategy (LFRMS) (Ref. 11);
- Surface Water Management Plan for THLBC (SWMP) (Ref. 12); and
- Thames Estuary 2100 (TE2100) Plan (Ref. 13).

4 RELEVANT PLANNING POLICES & DESIGNATIONS

4.1 NPPF and Flood Risk

With regard to flood risk and surface water drainage, the NPPF (Ref. 14) and its accompanying flood risk and coastal change Planning Practice Guidance (PPG) (Ref. 15) set out the Government's planning policy for England and advises on '*how to take account of and address the risks associated with flooding and coastal change in the planning process*'. The principal aim of the NPPF is to achieve sustainable development by accounting for flooding at all stages of the planning process, avoiding inappropriate development in areas at risk of flooding and directing development away from areas where risks are highest. Where development is necessary in areas at risk of flooding, the NPPF aims to ensure it is safe, without increasing flood risk to third parties. Early adoption of, and adherence to, the principles set out in the NPPF with respect to flood risk, can ensure that detailed designs and plans for development take due account of flood risk and the need for appropriate mitigation, if required.

4.2 The Sequential and Exception Tests

The PPG identifies four Flood Zone classifications, detailed in Table 1.

Table 1 Flood Zones (Source: Table 1 Flood Risk and Coastal Change PPG)

Flood Zone	Annual Probability of Flooding
1 – Low Probability	Fluvial and Tidal <0.1% (AEP)
2 – Medium Probability	Fluvial 0.1-1.0% AEP Tidal 0.1-0.5% AEP
3a – High Probability	Fluvial > 1.0% AEP Tidal > 0.5% AEP
3b – The Functional Floodplain	Fluvial and Tidal >5.0% AEP *Starting point for consideration. Local planning authorities should identify Functional Floodplain, which should not be defined solely by rigid probability parameters.

The NPPF specifies that the suitability of all new development in relation to flood risk should be assessed by applying the Sequential Test to demonstrate that there are no reasonably available sites in areas with a lower probability of flooding that would be appropriate to the type of development proposed. The NPPF provides guidance on the compatibility of each land use classification in relation to each of the Flood Zones, as summarised in Table 2.

Table 2 Flood Risk Vulnerability Classification (Source: Table 3 Flood Risk and Coastal Change PPG)

Flood Zone	Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	✓	Exception Test required	✓	✓
Zone 3a	Exception Test required	✓	X	Exception Test required	✓
Zone 3b	Exception Test required	✓	X	X	X
Key: ✓ Development is appropriate X Development should not be permitted					

When the Exception Test is triggered, this requires the development proposals to demonstrate wider sustainability benefits to the community that outweigh flood risk, and that the development will be safe for its lifetime, without increasing flood risk elsewhere and where possible reduce overall flood risk.

The Site has been assessed against these planning tests in Section 6 of this report.

5 FLOOD RISK SOURCES AND FLOODING HISTORY

5.1 Overview

In line with best practice, flood risk from the range of possible sources listed in Table 3 has been considered.

Table 3 Potential Sources of Flooding

Source of Flooding	Description
1. Flooding from the sea (Coastal and Tidal)	Flooding originating from the sea or a connected waterbody when seawater overflows onto land through extreme tidal conditions, storm surge or breach.
2. Flooding from rivers (Fluvial)	Floodwater originating from a nearby watercourse when the amount of water exceeds the channel capacity of that watercourse.
3. Flooding from land (Surface Water)	Flooding caused by intense rainfall exceeding the available infiltration and/or drainage capacity of the ground.
4. Flooding from groundwater	Flooding caused when groundwater levels rise above ground level following prolonged rainfall.
5. Flooding from reservoirs, canals and other artificial sources and sewers	Failure of infrastructure that retains or transmits water or controls its flow.

5.2 Historical Flooding

Historical flood records provided by the EA identify the Site as having no history of flooding from coastal, fluvial or surface water sources.

The THLBC Level 2 SFRA *Recorded Incidents of Sewer Flooding* map identifies flooding incidents within the Borough. No specific location information is provided, instead flood incidents are defined based on postal code. There are no recorded incidences of sewer flooding in the E1 3N area.

The THLBC PFRA holds one record of groundwater flooding affecting the Borough, consisting of standing water emergence on Eric Street in December 2004, which is located approximately 2.6km northeast of the Site.

5.3 Flood Defences

The River Thames is tidally dominated through London, with the most severe flood risks associated with tidal surges. However, land within the Thames floodplain is defended via a combination of raised banks, river walls and tidal barriers, most notably the Thames Barrier.

The Thames Barrier and associated defence system protect to the 1 in 1,000 year standard (0.1% annual probability). The EA states that *'if levels and flows are forecast to be any higher [than the 1 in 1,000 year standard] 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 upriver of the Barrier [beyond the 1 in 1,000 year standard] is controlled and therefore any associated return period becomes irrelevant.'*

In addition to the Thames Barrier, the River Thames is contained by river walls and raised banks. In proximity to the Site, the defences along the River Thames are raised to a height of 5.28mAOD. The EA describes the condition of these defences as 'Good'.

Through the combination of the operation of the Thames Barrier, river walls and other structures, it is considered that the Site is fully defended against flooding beyond the 0.1% annual probability extreme tide level.

The TE2100 Plan sets out the EA recommendations for flood risk management for London and the River Thames to 2100. The policy direction for the study area is to undertake future raising of the river walls on the River Thames to a minimum level of 6.35mAOD by 2100 in order to maintain standards of flood protection in the face of climate change.

The open air-vent on Site A is enclosed by a brick wall, approximately 2.5m high. It is considered that the primary function of this wall is for security.

5.4 Flooding from the Sea

The EA *Flood Map for Planning* (Figure 3) identifies the Site as in an 'area benefitting from flood defences'. This designation identifies areas that benefit from formal flood defences that protect to a minimum of a 1 in 200 (0.5%) standard from the sea. The residual flood risk to the Site, ignoring the presence of flood defences, identifies the Site in Flood Zone 3. This zone denotes land at high flood risk (having a greater than 1 in 200 (0.5%) annual probability of flooding from the sea). There is therefore a high residual flood risk to the Site from the River Thames in the unlikely event of a failure or breach of the defences.

Modelled water levels for the Site have been supplied by the EA, extracted from the TE2100 Plan. The TE2100 Plan provides values for the maximum likely floodwater level (1 in 1,000 year (0.1%) annual exceedance probability) for a present day scenario (2008) and two future scenarios (2065 and 2100), which incorporate allowance for climate change. Flood levels are provided for a model node (2.38) located on the River Thames approximately 300m east of the Site. The TE2100 Plan estimates extreme water levels of 4.76mAOD (present day, 2008) and design water levels of 5.27mAOD (future, 2065) and 5.75mAOD (future, 2100). These flood levels would result in overtopping of the current installed defences in the future 2100 scenario. However, the TE2100 Plan provides recommendations for continuous improvement of defences along the River Thames, including their raising and repair, in line with predicted climate change impacts. It is therefore anticipated that the Thames flood defences will be maintained to provide a 0.1% standard of protection over the lifetime of any proposed development at the Site.

It is therefore considered highly unlikely that the installed defences will be overtopped, instead the greatest tidal flood risk from the River Thames corresponds to a failure (breach) of the defences.

The EA *Thames Tidal Upriver Breach Modelling 2017 Map* (included in Appendix A), provides outlines for the predicted inundation areas following a breach of the River Thames' flood defences coinciding with a 1 in 1,000 year (0.1%) annual exceedance probability flood event. Outlines are provided for 2014 (present day) and 2100 (future) scenarios. The Site is located within the flood outline for both scenarios, with predicted flood levels and depths shown in Table 4. However, the likelihood of a defence breach is low, especially considering the TE2100 recommendation for the continuous improvement and repair for these assets.

Table 4 Thames Tidal Breach Modelling Flood Levels and Flood Depths

Site	Minimum Ground Elevation (mAOD)	2014 Scenario		2100 Scenario	
		Flood Level (mAOD)	Flood Depth (m)	Flood Level (mAOD)	Flood Depth (m)
A	3.42	3.78	0.35*	5.42	1.99*
B	3.18	3.73	0.55	5.42	2.25
C	2.63	4.01	1.37	5.41	2.78

*Flood depths on Site A have been calculated ignoring the presence of the air-vent.

Overall, it is considered that the Site is at low risk of tidal flooding, due to the protection afforded by flood defences. There is a high residual risk of flooding from this source in the unlikely event of defence failure (breach) in the future.

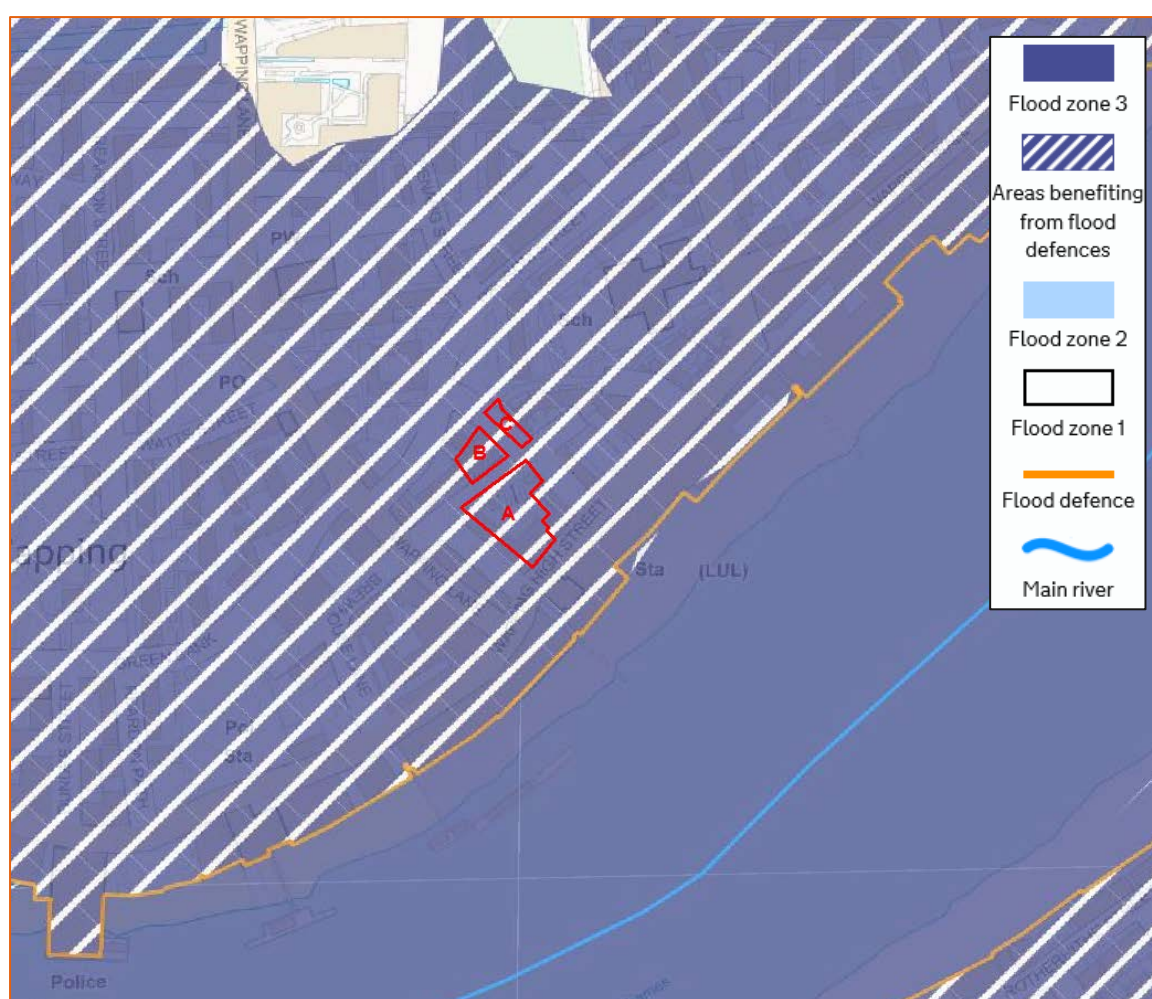


Figure 3: EA Flood Map for Planning. Site boundaries outlined in red.

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5.5 Flooding from Rivers

The EA *Flood Map for Planning* identifies the Site as located in an 'area benefitting from flood defences'. Modelled flood outlines supplied with the EA Product 4 data pack (Appendix A) show that the Site is fully defended for fluvial flood scenarios up to and including the 1 in 1,000 (0.1%) annual exceedance probability and therefore has a very low susceptibility to flooding from this source. Residual flood levels and depths, ignoring the presence of defences, are shown in Table 5.

Table 5 River Thames Flood Levels and Flood Depths

Site	Minimum Ground Elevation (mAOD)	2014 - Present		2065 to 2100		2100	
		Design Flood Level (mAOD)	Flood Depth (m)	Design Flood Level (mAOD)	Flood Depth (m)	Design Flood Level (mAOD)	Flood Depth (m)
A	3.42	4.76	1.34*	5.27	1.85*	5.75	2.33*
B	3.18	4.76	1.58	5.27	2.09	5.75	2.57
C	2.63	4.76	2.13	5.27	2.64	5.75	3.12

*Flood depths on Site A have been calculated ignoring the presence of the air-vent.

The EA *Flood Map for Planning* and EA Flood Zone classifications do not illustrate flood risk from all non-Main River sources (ordinary watercourses). However, no ordinary watercourses have been identified in proximity to the Site.

Overall, it is considered that the Site is at low risk of fluvial flooding, due to the protection afforded by the flood defences, but has a high residual risk of flooding from this source in the unlikely event of defence failure (breach) in the future.

5.6 Flooding from Surface Water

The THLBC SWMP and LFRMS identify that surface water flooding poses the most significant flood risk in the Borough. This risk is due to rapid urbanisation and the subsequent increase in paved and impermeable surfacing. Most rainfall drains and is piped away via the combined sewer system. However, the sewer system has limited capacity and in response to intense or heavy rainstorms topographical low points are at risk of surface water flooding.

The SWMP for THLBC identifies 14 Critical Drainage Areas (CDAs) in the Borough, but the Site is not located within one of these areas.

The EA *Flood Risk from Surface Water* map (Figure 4) identifies most of the Site as having a very low risk (having a less than 1 in 1,000 (0.1%) annual probability) of surface water flooding. The northern extent of Site C, neighbouring Hilliard Crescent, as well as sections of Cinnamon Street, Hilliard Street and Clegg Street are designated as having a low risk (between a 1 in 100 (1%) and 1 in 1,000 (0.1%) annual probability) of flooding from this source.

There are several scattered areas of medium to high probability of surface water flooding in proximity to the Site. These areas correspond to areas of lower topography where surface water is likely to pool or represent surface water overland flow paths, posing no constraint to development of the Site.

Overall, it is considered that the Site is at a low risk of surface water flooding.

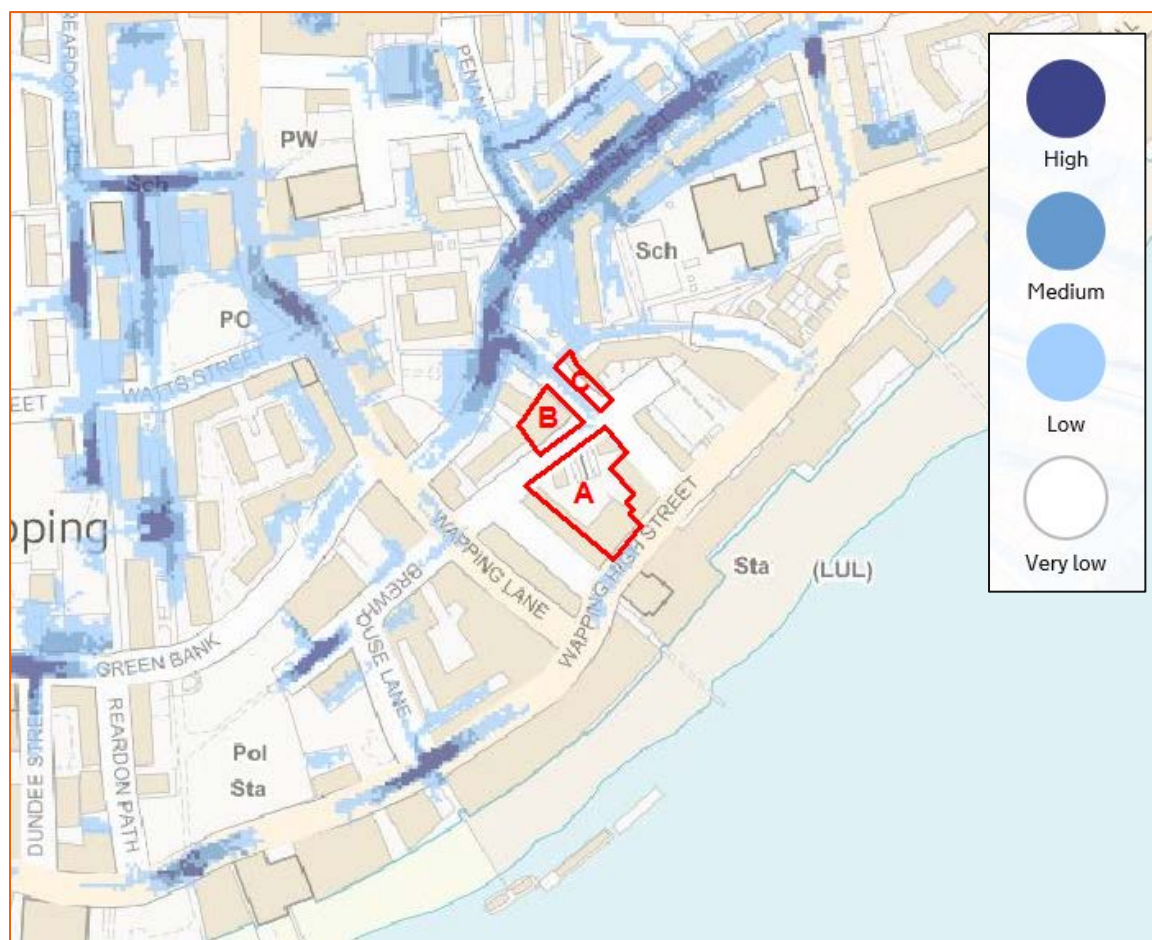


Figure 4: EA Risk of Flooding from Surface Water. Site boundaries outlined in red. Contains EA data © Crown copyright and database right 2017. All rights reserved.

5.7 Flooding from Sewers

The THLBC Level 2 SFRA states that *'the risk of flooding from sewers is increasing due to the increasing urbanisation of areas and rising rainfall intensities'* and *'the sewer network in London cannot cope'*. However, there are no records of sewer flooding within the E1 3N postal district.

The sewer network mainly consists of combined sewers, and sewer flood risk is therefore intrinsically linked to surface water flood risk, which is low.

Overall, it is considered that the Site is at low risk of sewer flooding, however it is recommended that consultation with Thames Water should be undertaken to understand the capacity of the local network serving the Site.

5.8 Flooding from Groundwater

The THLBC LFRMS states that there are localised areas in the Borough with *'more permeable substrate/ground'* and that therefore have a *'higher potential for groundwater flooding'*. However, this risk would only occur following the alignment of numerous factors, including the end/reduction of groundwater abstraction, significant periods of prolonged rainfall and/or the introduction of barriers to groundwater flow.

The PFRA *Increased Potential for Elevated Groundwater Map* does not identify the Site in an area with permeable superficial deposits. The Site is underlain by a Secondary (undifferentiated) superficial aquifer and a Secondary A bedrock aquifer, therefore there is considered to be limited potential for

groundwater emergence. The PFRA notes one incident of groundwater flooding located more than 2.5km from the Site.

The open air-vent may provide a pathway for groundwater emergence, especially given the proximity and potential connectivity to the River Thames. However, it is considered the air-vent is sufficiently protected against flooding and there is no history of groundwater emergence.

Overall, it is considered that the Site is at low risk of groundwater flooding.

5.9 Flooding from Artificial Sources

The EA *Risk of Flooding from Reservoirs* map indicates that the Site is not located within the maximum extent of reservoir flooding should large reservoirs fail and release the water that they hold.

The Site is located remote from any other sources of artificial flooding.

Overall, it is considered that the Site is at low risk of flooding from artificial sources.

6 RISK RATING & RECOMMENDATIONS FOR FURTHER INVESTIGATION

Following an assessment of flood risk to the Site, it is considered that there is a **Low** risk of flooding from all sources. The degree of tidal and fluvial flood risk is dependent on the installed defences on the River Thames. These defences protect the Site up to the 0.1% flood event in the present day. In accordance with TE2100 policy these assets should be maintained to provide the same level of protection into the future, accounting for the predicted effects of climate change.

Table 6 Flood Risk Sources

Source of Flooding	Flood Risk
1. Flooding from the sea (Coastal and Tidal)	Low (High Residual)
2. Flooding from rivers (Fluvial)	Low (High Residual)
3. Flooding from land (Surface Water)	Low
4. Flooding from groundwater	Low
5. Flooding from reservoirs, canals and other artificial sources	Low
6. Flooding from sewers	Low

Following the NPPF guidance, the Site would be suitable for ‘*Water Compatible*’ and ‘*Less Vulnerable*’ development types but would trigger application of the Exception Test for ‘*More Vulnerable*’ (which includes residential land use) and ‘*Essential Infrastructure*’ uses. The Site would not be appropriate for ‘*Highly Vulnerable*’ development types (which notably includes basement dwellings).

As a defended Site, there is a residual risk of flooding, and any future planning application for development of the Site would need to be informed by a Flood Risk Assessment (FRA). The FRA would present a more detailed assessment than is provided by this Flood Risk Review and would need to be specific to the type and layout/configuration of development that is proposed. The FRA should demonstrate that any proposed development would not be subject to an unreasonable risk of flooding and would not increase flood risk to third parties. If proven, this would satisfy the NPPF Exception Test.

It is considered that there is a low risk of surface water flooding and sewer flooding, however there is an increasing risk of surface water and sewer flooding in the Borough. Surface water drainage and runoff from the Site, including available connections with and capacity of the local sewer network, should be further investigated. It should be ensured that drainage is managed to a high standard. Further investigation should include the calculation of current rainfall-runoff rates and volumes, greenfield runoff rates for the Site and confirmation of the available capacity of the local and wider sewer networks.

The air-vent has a very high residual risk to flooding from all sources and may provide a pathway for groundwater emergence. An assessment of the flood risk to the air-vent would need to be considered as part of the Flood Risk Assessment.

A Drainage Strategy should be developed in consultation with the Lead Local Flood Authority, detailing methods to manage runoff from the Site, which would ideally be controlled to match greenfield rates by adopting suitable Sustainable Drainage (SuDS) techniques.

Overall, it is considered that, except for basement dwellings, the Site is appropriate for residential and most other forms of development.

7 REFERENCES

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APPENDIX A

Environment Agency Flood Product 4 and Flood Product 8 Data Packs

Product 4 (Detailed Flood Risk) for: Sites off Wapping High Street, Wapping,
E1W 3NJ

Reference: HNL89472AS

Date: 21/06/2018

Contents

- Flood Map for Planning (Rivers and Sea)
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- Thames Tidal Upriver Breach Inundation Modelling 2017
- Thames Tidal Upriver Breach Inundation Modelling Map
- Site Node Locations Map
- Defence Details
- Recorded Flood Events Data
- Recorded Flood Events Outlines Map
- Additional Information

The information provided is based on the best data available as of the date of this letter.

You may feel it is appropriate to contact our office at regular intervals, to check whether any amendments/ improvements to the data for this location have been made. Should you re-contact us after a period of time, please quote the above reference in order to help us deal with your query.

Please refer to the [Open Government Licence](#) which explains the permitted use of this information.

Flood Map for Planning (Rivers and Sea)

The Flood Map:

Our Flood Map shows the natural floodplain for areas at risk from river and tidal flooding. The floodplain is specifically mapped ignoring the presence and effect of defences. Although flood defences reduce the risk of flooding they cannot completely remove that risk as they may be over topped or breached during a flood event.

The Flood Map indicates areas with a 1% (0.5% in tidal areas), Annual Exceedance Probability (AEP) - the probability of a flood of a particular magnitude, or greater, occurring in any given year, and a 0.1% AEP of flooding from rivers and/or the sea in any given year. In addition, the map also shows the location of some flood defences and the areas that benefit from them.

The Flood Map is intended to act as a guide to indicate the potential risk of flooding. When producing it we use the best data available to us at the time and also take into account historic flooding and local knowledge. The Flood Map is updated on a quarterly basis to account for any amendments required. These amendments are then displayed on the internet at <https://www.gov.uk/check-flood-risk>

At this Site:

The Flood Map shows that this site lies within Flood Zone 3 - with a 0.5% chance of flooding from the sea (tidal flooding) in any given year.

Enclosed is an extract of our Flood Map which shows this information for your area.

Method of production

The Flood Map at this location has been derived using detailed modelling of the tidal River Thames through the Thames Tidal Defences Study completed in 2006 by Halcrow Ltd.

Thames Estuary 2100 (TE2100)

You have requested in-channel flood levels for the tidal river Thames. These have been taken from the Thames Estuary 2100 study completed by HR Wallingford in 2008. The modelled node closest to your site is **2.38**; the locations of nearby nodes are also shown on the enclosed map.

Details about the TE2100 plan

The TE2100 plan is now live and within it are a set of levels on which the flood risk management strategy is based. The plan is the overarching flood management strategy for the Thames Estuary and therefore any development planning should be based on the same underlying data.

Details about the TE2100 in-channel levels

The TE2100 in-channel levels take into account operation of the Thames Barrier when considering future levels. The Thames Barrier requires regular maintenance and with additional closures the opportunity for maintenance will be reduced. When this happens, river levels – for which the Barrier would normally shut for the 2008 epoch – will have to be allowed through to ensure that the barrier is not shut too often. For this reason, levels upriver of the barrier will increase and the tidal walls will need to be heightened to match.

Why is there no return period for levels upriver of the barrier?

The levels upriver 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 upriver 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.

TE2100 2008 levels:

Levels downriver of the Thames Barrier are 0.1% AEP (1 in 1000) and levels upriver are the highest levels permitted by the Thames Barrier, described as the Maximum Likely Water Levels (MLWLs). The defence levels (left defence, right defence) are the minimum levels to which the defences should be built.

Location	Node	Easting	Northing	Extreme water level (m)	Left defence (m)	Right defence (m)	Allow for future defence raising to a level of...	
							Left Bank (m)	Right Bank (m)
Tower	2.37	534519	179917	4.78	5.28	5.28	6.35	6.35
	2.38	535264	180141	4.76	5.28	5.28	6.35	6.35
	2.39	536040	180673	4.74	5.23	5.23	6.20	6.20

TE2100 climate change levels:

Location	Node	Easting	Northing	2065 to 2100		2100	
				Design water level	Defence level (both banks)	Design water level	Defence level (both banks)
Tower	2.37	534519	179917	5.27	5.85	5.76	6.35
	2.38	535264	180141	5.27	5.85	5.75	6.35
	2.39	536040	180673	5.25	5.70	5.74	6.20

Thames Tidal Upriver Breach Inundation Modelling

The table below displays site-specific modelled flood levels at your site. These have been taken from the Thames Tidal Upriver Breach Inundation Modelling Study 2017 completed by Atkins Ltd. in May 2017.

We have developed a modelling approach where all upriver breach locations along the Thames are equitably modelled, to ensure a consistent approach across London. This modelling simulates 5679 continuous tidal breaches along the entire extent of the Thames from Teddington to the Thames Barrier. For hard and composite defences breaches are set at 20 m wide; for soft defences, breaches are 50 m wide. In both cases, the defence breach scour distance was assumed to extend into the floodplain by the same distance as the breach width.

For breaches upriver of the Thames Barrier, there is no return period for modelled levels as the levels are controlled by barrier closures. The levels used are referred to as Maximum Likely Water Levels (MLWLs). Therefore 2014 and 2100 epochs were modelled on that basis.

Node	National Grid Reference		Modelled levels in mAODN for Max Likely Water Level	
	Easting	Northing	2014	2100
0	535010	180196	4.620	5.397
1	535021	180209	4.620	5.400
2	535012	180231	4.433	5.409
3	534991	180212	4.424	5.408
4	535005	180254	3.778	5.416
5	534973	180226	4.045	5.408
6	534967	180257	3.729	5.423
7	534983	180254	3.729	5.423
8	534977	180274	3.729	5.423
9	534987	180286	4.007	5.410
10	535004	180268	3.878	5.410
11	534998	180256	3.764	5.415

Defence Details

The design standard of protection of the flood defences in this area of the Thames is 0.1% AEP; they are designed to defend London up to a 1 in 1000 year **tidal** flood event. The defences are all raised, man-made and privately owned. It is the riparian owners' responsibility to ensure that they are maintained to a crest level of 5.28 AODN (the Statutory Flood Defence Level in this reach of the Thames). We inspect them twice a year to ensure that they remain fit for purpose. The current condition grade for defences in the area is **2 (good)**, on a scale of 1 (very good) to 5 (very poor). For more information on your rights and responsibilities as a riparian owner, please see our document 'Living on the edge' found on our website at:

<https://www.gov.uk/government/publications/riverside-ownership-rights-and-responsibilities>

There are no planned improvements in this area. Please see the 'Thames Estuary 2100' document on our website for the short, medium and long term Flood Risk Management strategy for London:

<https://www.gov.uk/government/publications/thames-estuary-2100-te2100>

Areas Benefiting from Flood Defences

This site is within an area benefiting from flood defences, as shown on the enclosed extract of our Flood Map. Areas benefiting from flood defences are defined as those areas which benefit from formal flood defences specifically in the event of flooding from rivers with a 1% (1 in 100) chance in any given year, or flooding from the sea with a 0.5% (1 in 200) chance in any given year.

If the defences were not there, these areas would be flooded. An area of land may benefit from the presence of a flood defence even if the defence has overtopped, if the presence of the defence means that the flood water does not extend as far as it would if the defence were not there.

Recorded Flood Events Data

We hold records of historic flood events from rivers and the sea. Information on the floods that may have affected the area local to your site are provided in the enclosed map.

Due to the fact that our records are not comprehensive, we would advise that you make further enquiries locally with specific reference to flooding at this location. You should consider contacting the relevant Local Planning Authority and/or water/sewerage undertaker for the area.

We map flooding to land, not individual properties. Our historic flood event record outlines are an indication of the geographical extent of an observed flood event. Our historic flood event outlines do not give any indication of flood levels for individual properties. They also do not imply that any property within the outline has flooded internally.

Please be aware that flooding can come from different sources. Examples of these are:

- from rivers or the sea;
- surface water (i.e. rainwater flowing over or accumulating on the ground before it is able to enter rivers or the drainage system);
- overflowing or backing up of sewer or drainage systems which have been overwhelmed,
- groundwater rising up from underground aquifers

Currently the Environment Agency can only supply flood risk data relating to the chance of flooding from rivers or the sea. However you should be aware that in recent years, there has been an increase in flood damage caused by surface water flooding and drainage systems that have been overwhelmed.

Other Sources of Flood Risk

The Lead Local Flood Authority for your area are responsible for local flood risk (i.e. surface runoff, ground water and ordinary watercourse) and may hold further information .

You may also wish to consider contacting the appropriate relevant Local Planning Authority and/or water/sewerage undertaker for the area. They may be able to provide some knowledge on the risk of flooding from other sources.

Additional Information

Use of Environment Agency Information for Flood Risk / Flood Consequence Assessments

Important

If you have requested this information to help inform a development proposal, then we recommend that you undertake a formal pre-application enquiry using the form available from our website:-

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

Depending on the enquiry, we may also provide advice on other issues related to our responsibilities including flooding, waste, land contamination, water quality, biodiversity, navigation, pollution, water resources, foul drainage or Environmental Impact Assessment.

In **England**, you should refer to the Environment Agency's Flood Risk Standing Advice, the technical guidance to the National Planning Policy Framework and the existing PPS25 Practice Guide for information about what flood risk assessment is needed for new development in the different Flood Zones. These documents can be accessed via:

<https://www.gov.uk/flood-risk-standing-advice-frsa-for-local-planning-authorities>

<https://www.gov.uk/government/publications/national-planning-policy-framework-technical-guidance>

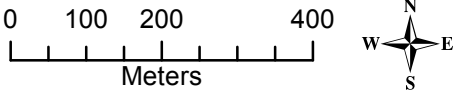
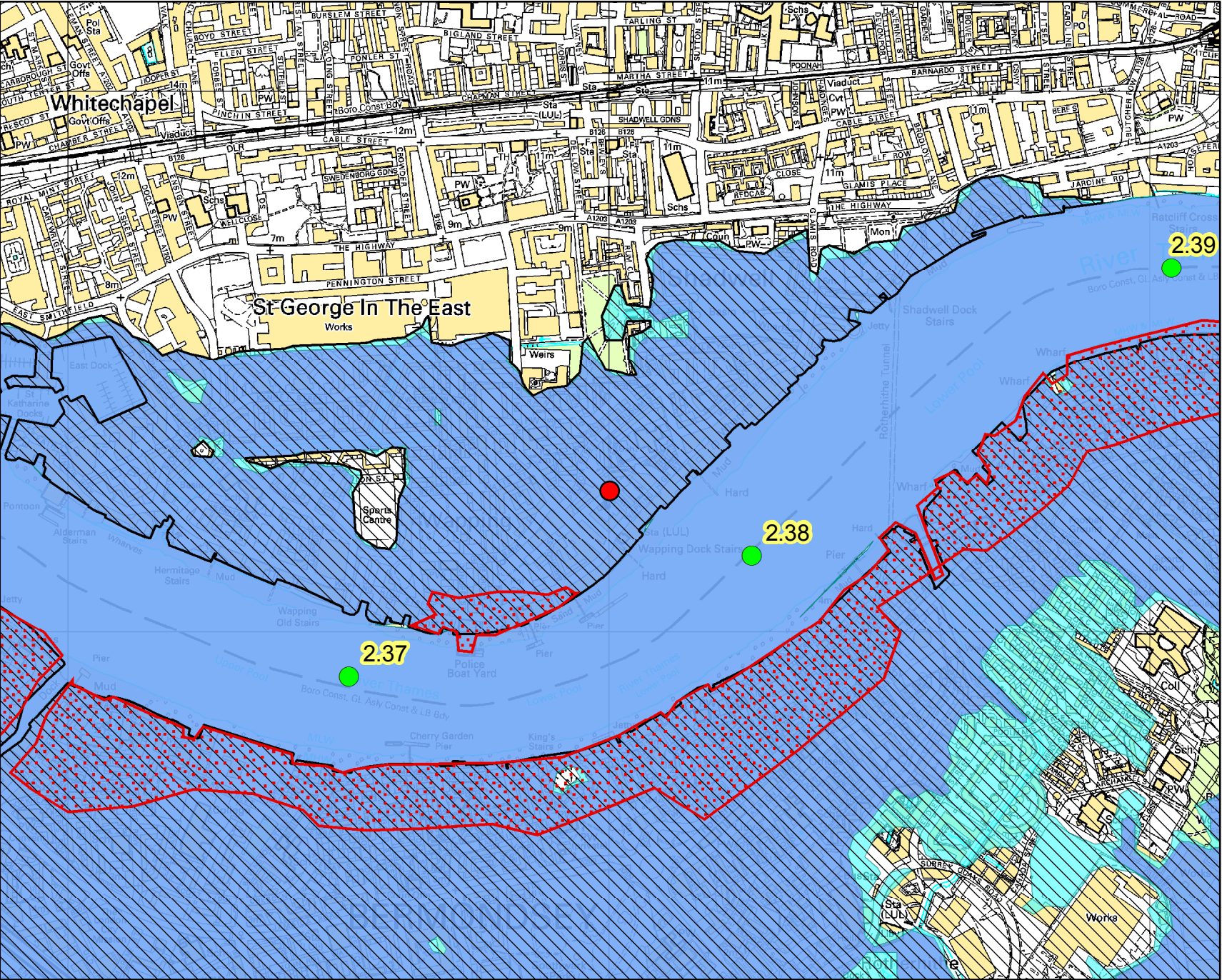
<https://www.gov.uk/government/publications/development-and-flood-risk-practice-guide-planning-policy-statement-25>

You should also consult the Strategic Flood Risk Assessment produced by your local planning authority.

You should note that:

1. Information supplied by the Environment Agency may be used to assist in producing a Flood Risk / Consequence Assessment (FRA / FCA) where one is required, but does not constitute such an assessment on its own.
2. This information covers flood risk from main rivers and the sea, and you will need to consider other potential sources of flooding, such as groundwater or overland runoff. The information produced by the local planning authority referred to above may assist here.
3. Where a planning application requires a FRA / FCA and this is not submitted or deficient, the Environment Agency may well raise an objection.
4. For more significant proposals in higher flood risk areas, we would be pleased to discuss details with you ahead of making any planning application, and you should also discuss the matter with your local planning authority.

Detailed FRA/FCA for: Sites off Wapping High Street, Wapping E1W 3NJ - 21/06/2018 - HNL89472AS



- Legend**
- Site Location
 - TE2100Nodes
 - 1707 Flood Outline
 - 1928 Flood Outline
 - 1953 Flood Outline
 - Areas Benefiting from Flood Defences
 - Flood Zone 3
 - Flood Zone 2

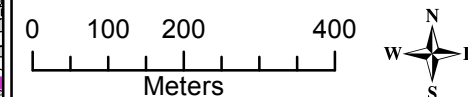
Flood Map for Planning (assuming no defences)

Flood Zone 3 shows the area that could be affected by flooding:

- from the sea with a 0.5% or greater chance of occurring each year
- or from a river with a 1% or greater chance of occurring each year.

Flood Zone 2 shows the extent of an extreme flood from rivers or the sea with up to a 0.1% chance of occurring each year.

Detailed FRA/FCA for: Sites off Wapping High Street, Wapping E1W 3NJ - 21/06/2018 - HNL89472AS



Legend

- Site Location
- TTD Defences SDL (mAODN)
SDL
- 5.23
- 5.28

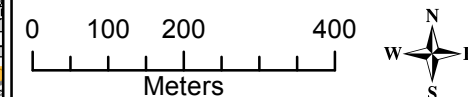
Flood Map for Planning (assuming no defences)

Flood Zone 3 shows the area that could be affected by flooding:

- from the sea with a 0.5% or greater chance of occurring each year
- or from a river with a 1% or greater chance of occurring each year.

Flood Zone 2 shows the extent of an extreme flood from rivers or the sea with up to a 0.1% chance of occurring each year.

Breach Modelling Map for: Sites off Wapping High Street, Wapping E1W 3NJ - 21/06/2018 - HNL89472AS



Legend

● Site Location

Upstream Breach Outlines

Epoch

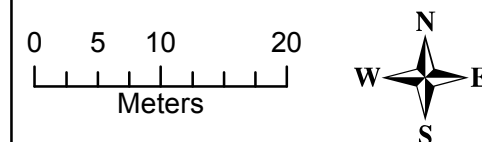
2005

2100

Thames Tidal Upriver Breach Inundation Modelling 2017

A modelled representation of all upriver tidal breach locations along the Thames from Teddington to the Thames Barrier, based on low floodplain topography. For hard and composite defences breaches are set at 20 m wide; for soft defences, breaches are 50 m wide. In both cases, the defence breach scour distance was assumed to extend into the floodplain by the same distance as the breach width. The modelling is based on the 2008 TE2100 in-channel levels, with an allowance for climate change for epoch 2100.

Modelled Flood Levels For: Sites off Wapping High Street, Wapping E1W 3NJ - 21/06/2018 - HNL89472AS

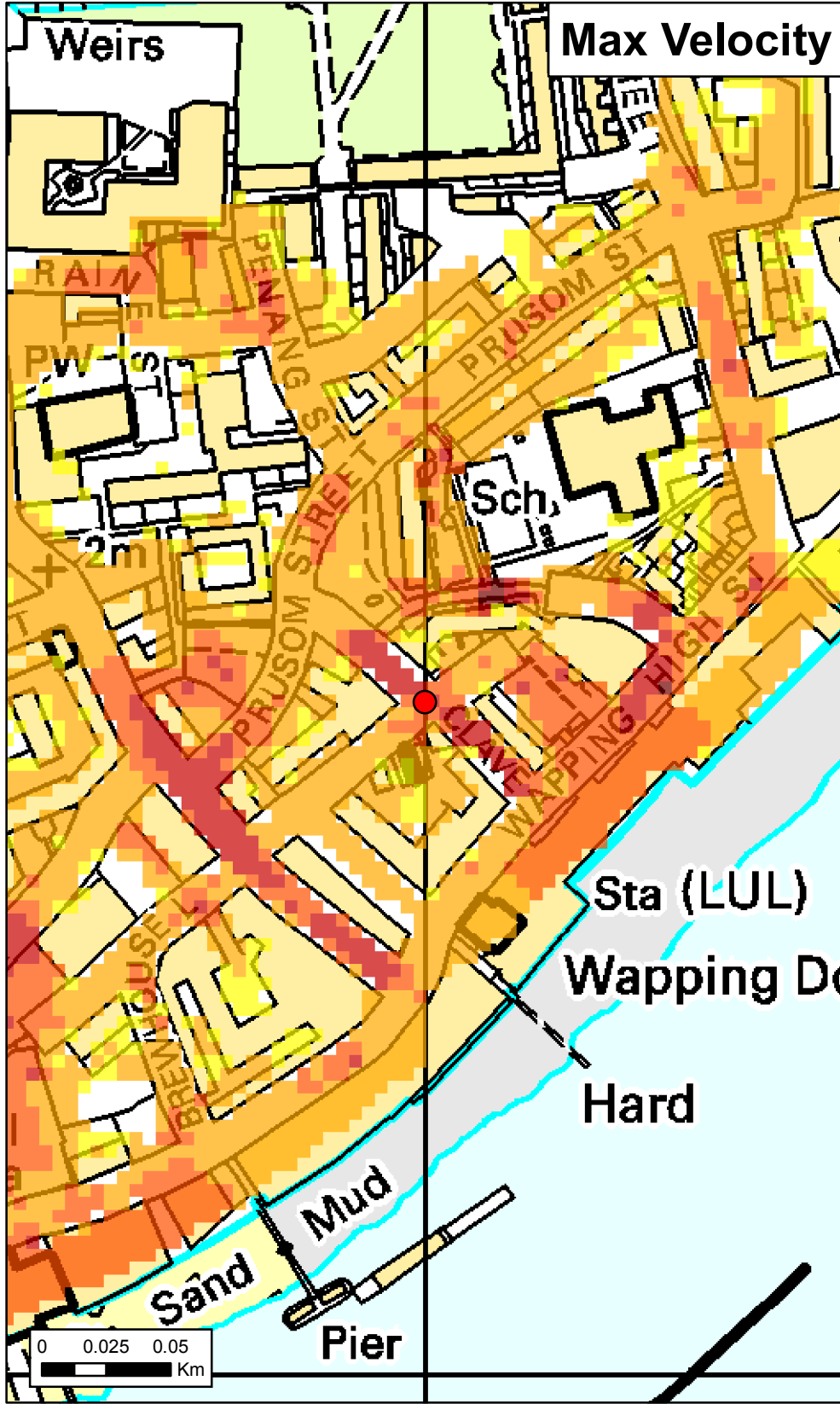
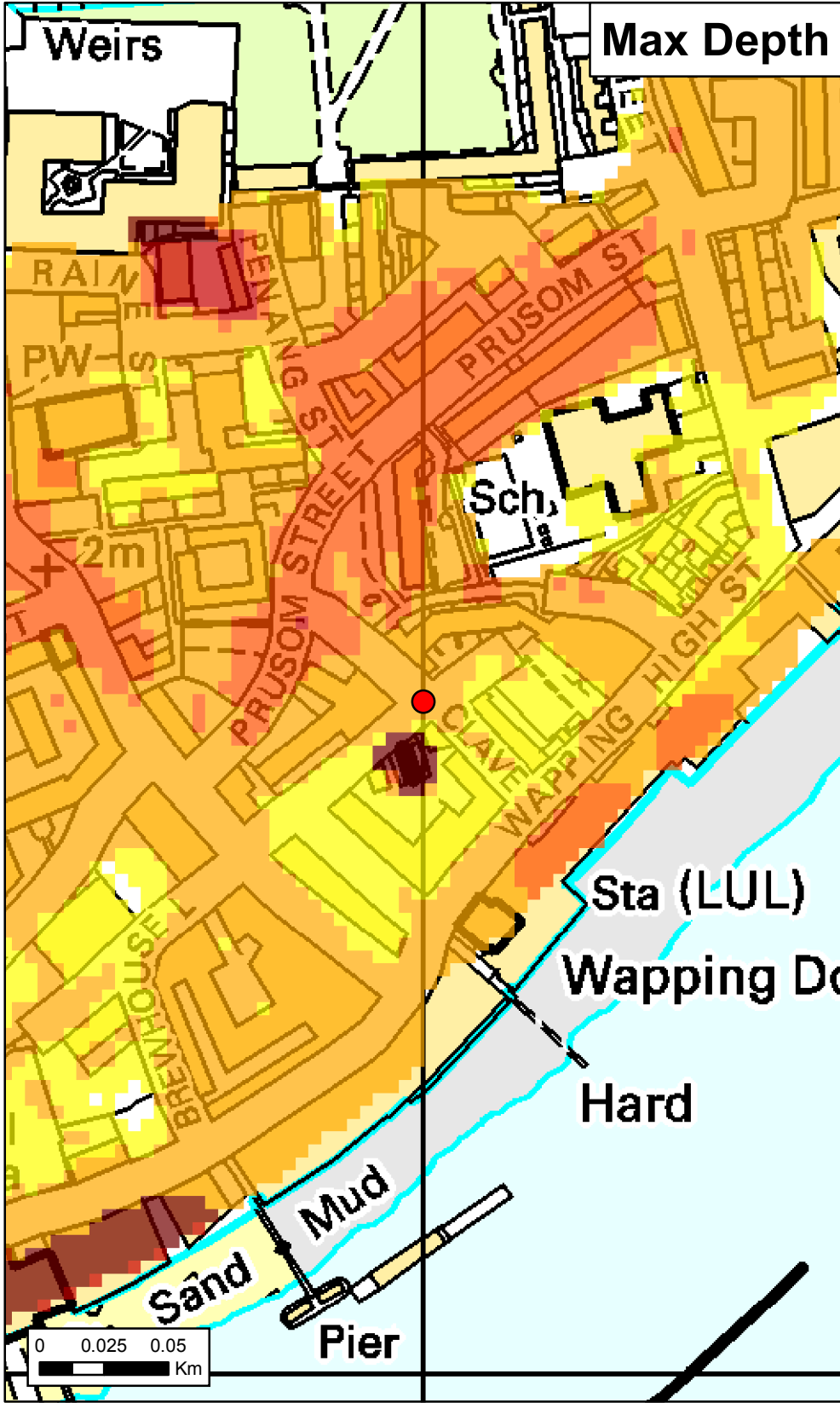
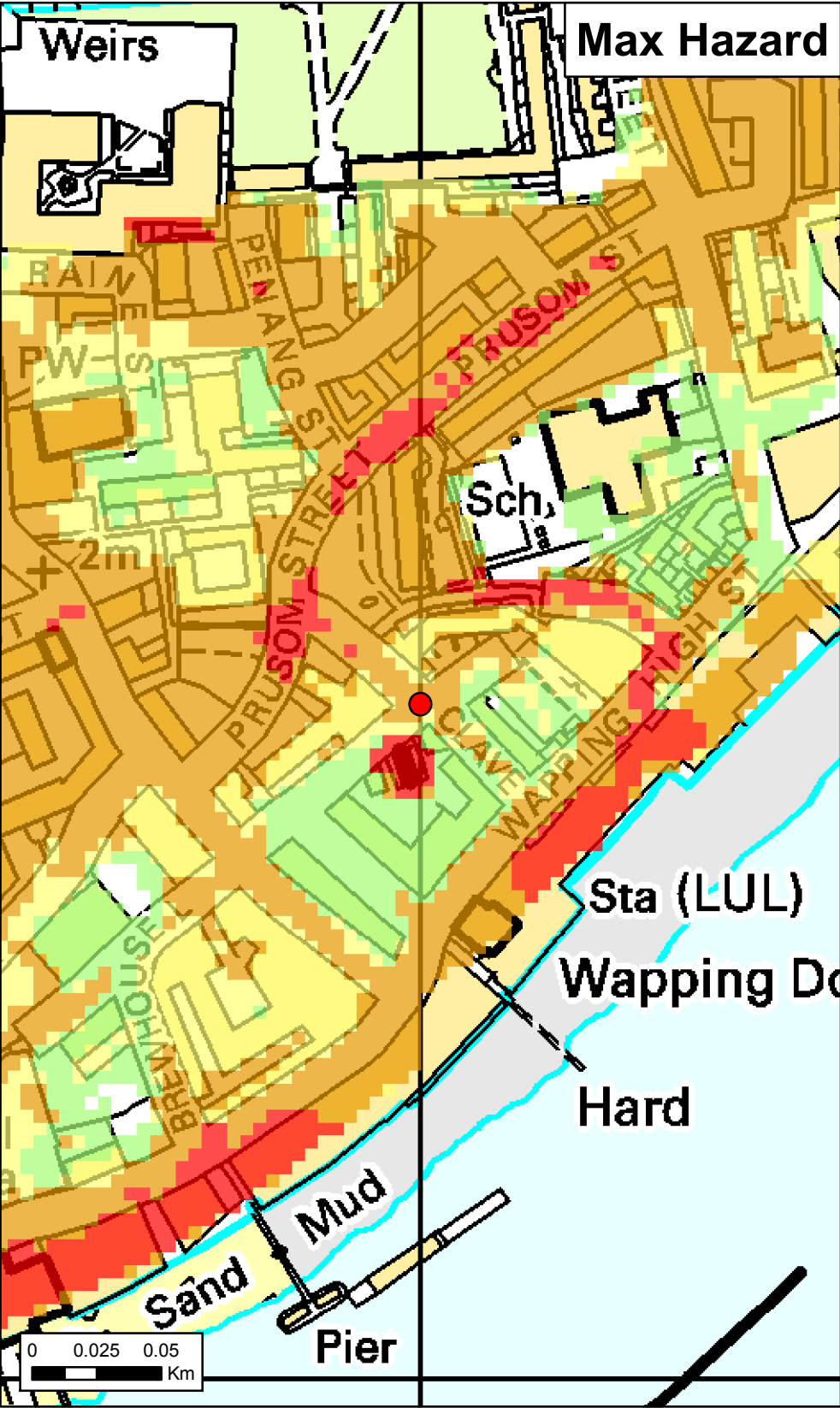


Legend

- Site Location
- Points

Thames Tidal Upriver Breach Inundation Modelling 2017

A modelled representation of all upriver tidal breach locations along the Thames from Teddington to the Thames Barrier, based on low floodplain topography. For hard and composite defences breaches are set at 20 m wide; for soft defences, breaches are 50 m wide. In both cases, the defence breach scour distance was assumed to extend into the floodplain by the same distance as the breach width. The modelling is based on the 2008 TE2100 in-channel levels, with an allowance for climate change for epoch 2100.



Max Hazard		Max Depth (m)		Max Velocity (m/s)	
	Less than 0.75 (Low Hazard)		0 - 0.25		0 - 0.3
	Between 0.75 and 1.25 (Danger for Some)		0.25 - 1.00		0.3 - 1.0
	Between 1.25 and 2.00 (Danger for Most)		1.00 - 1.50		1.0 - 1.5
	Greater than 2.00 (Danger for All)		1.50 - 2.00		1.5 - 2.5
			> 2.00		> 2.5
Date Printed	21/06/2018	Scenario year	2014	Scenario Annual Chance	0.1% (1 in 1000)

This map shows the level of flood hazard to people (called a hazard rating) if our flood defences are breached at certain locations, for a range of scenarios. The hazard rating depends on the depth and velocity of floodwater, and maximum values of these are also mapped.

The map is based on computer modelling of simulated breaches at specific locations. Each breach has been modelled individually and the results combined to create this map. Multiple breaches, other combinations of breaches, different sized tidal surges or flood flows may all give different results.

The map only considers the consequences of a breach, it does not make any assumption about the likelihood of a breach occurring. The likelihood of a breach occurring will depend on a number of different factors, including the construction and condition of the defences in the area. A breach is less likely where defences are of a good standard, but a risk of breaching remains.

Please contact the Environment Agency for further information on emergency planning associated with flood risk in this area.

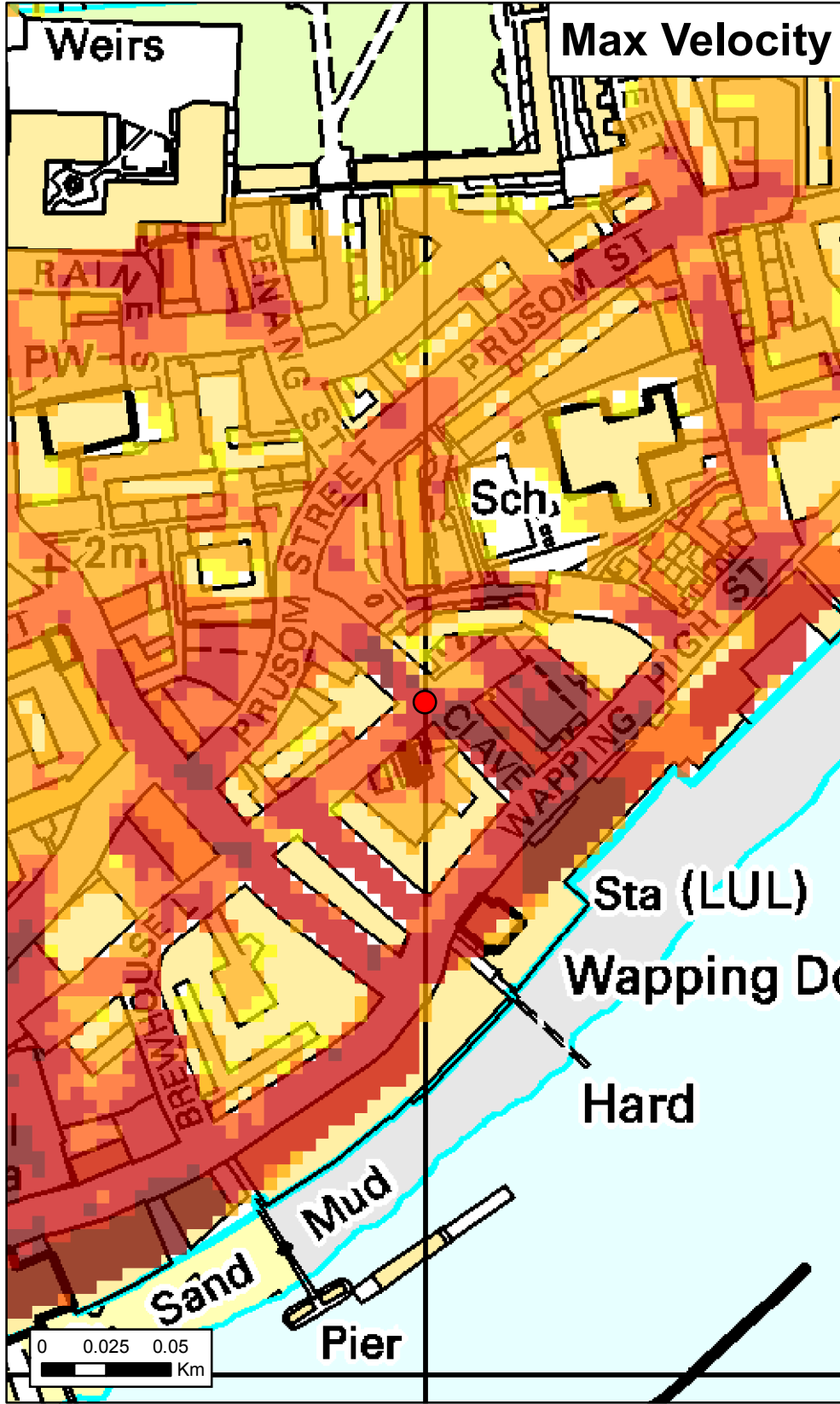
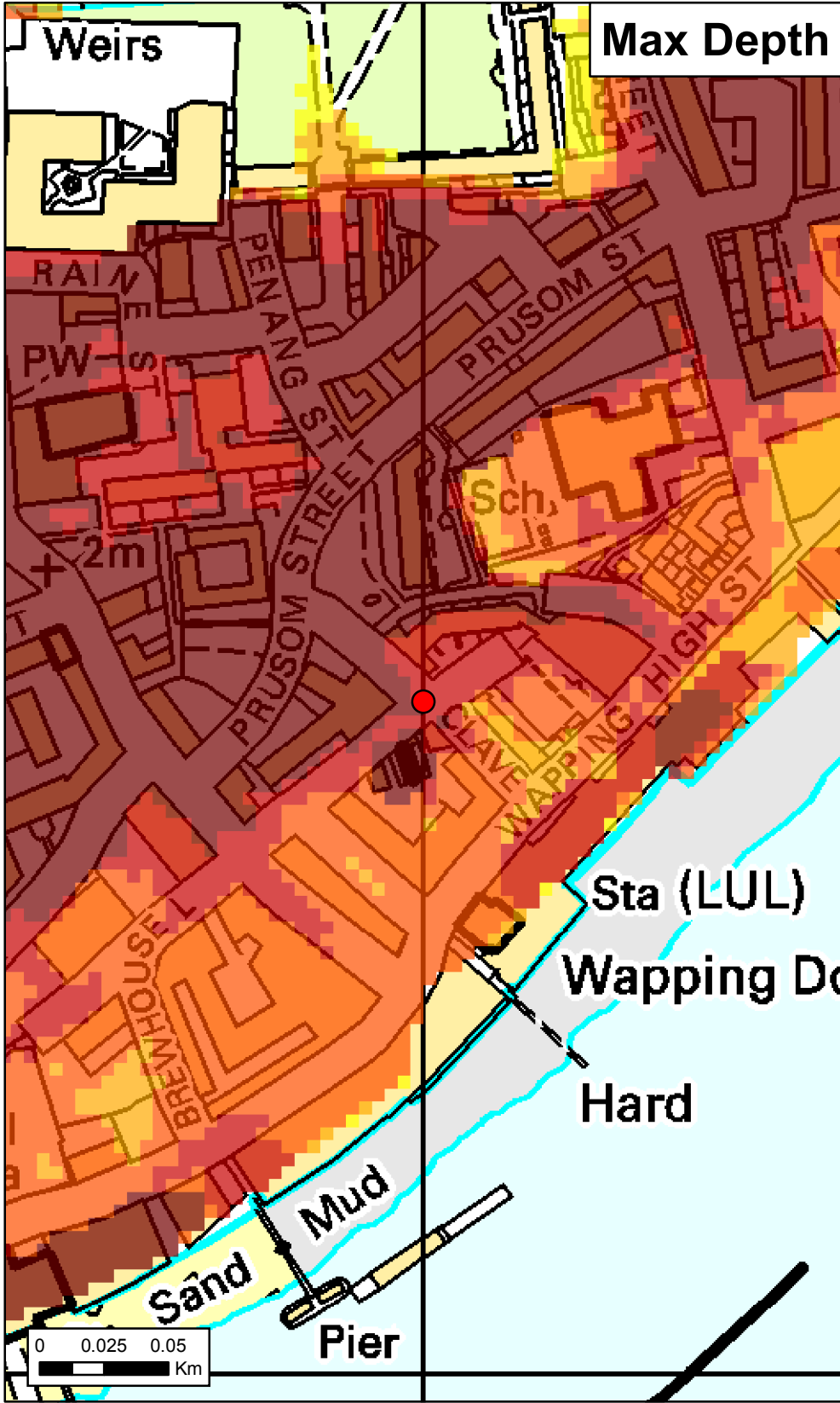
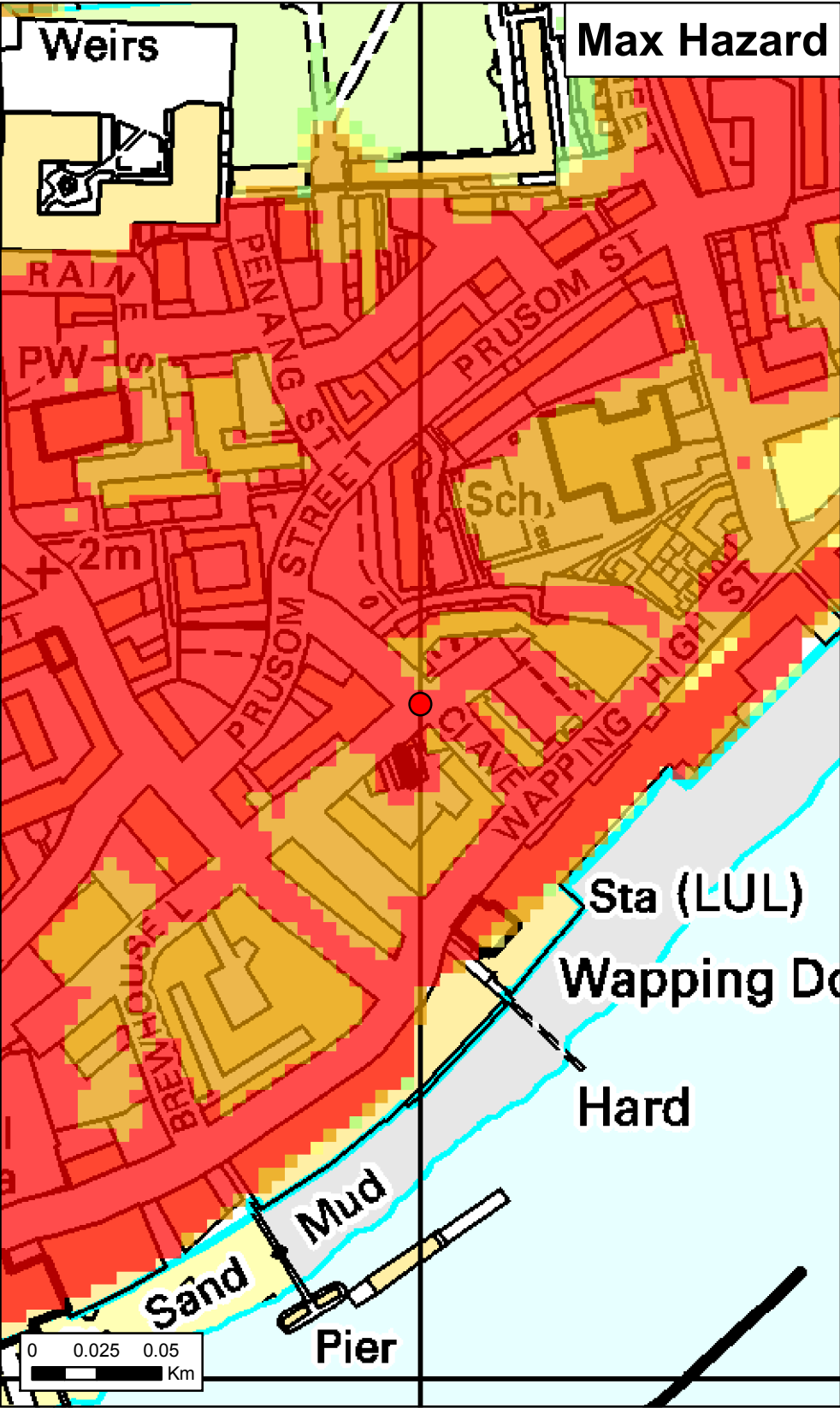
General Enquiries No: 03708 506 506. Weekday Daytime calls cost 5p plus up to 6p per minute from BT Weekend Unlimited. Mobile and other providers' charges may vary



Thames Tidal Breach Hazard Mapping

Map Centred on 535000, 180260

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Max Hazard		Max Depth (m)		Max Velocity (m/s)	
	Less than 0.75 (Low Hazard)		0 - 0.25		0 - 0.3
	Between 0.75 and 1.25 (Danger for Some)		0.25 - 1.00		0.3 - 1.0
	Between 1.25 and 2.00 (Danger for Most)		1.00 - 1.50		1.0 - 1.5
	Greater than 2.00 (Danger for All)		1.50 - 2.00		1.5 - 2.5
			> 2.00		> 2.5
Date Printed	21/06/2018	Scenario year	2100	Scenario Annual Chance	0.1% (1 in 1000)

This map shows the level of flood hazard to people (called a hazard rating) if our flood defences are breached at certain locations, for a range of scenarios. The hazard rating depends on the depth and velocity of floodwater, and maximum values of these are also mapped.

The map is based on computer modelling of simulated breaches at specific locations. Each breach has been modelled individually and the results combined to create this map. Multiple breaches, other combinations of breaches, different sized tidal surges or flood flows may all give different results.

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General Enquiries No: 03708 506 506. Weekday Daytime calls cost 5p plus up to 6p per minute from BT Weekend Unlimited. Mobile and other providers' charges may vary



Thames Tidal Breach Hazard Mapping

Map Centred on 535000, 180260

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