

LLDC
Flood Risk Review
Summary Report

Issue 2 | 13 January 2017

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

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1 Introduction

1.1 General

The London Legacy Development Corporation (LLDC) is the Local Planning Authority for its area and holds the responsibility for development management and plan making. The Legacy Corporation has developed a Local Plan which was adopted in 2015 which sets out the strategy for the sustainable development of its area up until the year 2031. The Legacy Corporation however is not the lead flood or drainage authority, of which this responsibility remains with the respective Boroughs (Hackney, Newham, Tower Hamlets and Waltham Forest).

As part of the evidence base for the Local Plan, Hyder Consulting carried out a Flood Risk Review with the available evidence and information on flood risk which informed relevant policies within the Local Plan. This included Sequential and Exceptions Testing as per Planning Practice Guidance (PPG).

Since this Flood Risk Review was published, the EA have significantly updated their Flood Risk mapping in the LLDC area as well as publishing new guidance on the assessment for climate change allowance.

The purpose of this report is to provide guidance on updating the SFRA's in line with this new information. It will also help inform the approach which may be taken to flood risk and guidance in the three area based supplementary planning documents being prepared in support of the Local Plan.

1.2 Scope of Works

The scope of works for this flood risk review following updated flooding data published by the Environment Agency (EA) is as follows:

- To update information available in respect of the extent and level of flood risk within the LLDC area based on the most recent EA flood mapping and any other relevant available information.
- Within the percentage range specified for the Thames catchment within the Planning Practice Guidance, identify the approximate percentage of climate change allowance that should be considered for each key flood risk location (acknowledging that site/ development specific flood risk assessments will need to verify or update this at the point these are prepared in support of any planning application).
- Determine the approximate extent and depth of the flooding likely from a 1 in 100 year return period + climate change flood event in key flood risk locations within the area, including the locations for the three area based SPD's currently being prepared.
- Review and update the recommended measures and actions from the existing SFRA's and Sequential / Exception Tests for those locations.

- Update any breach assessments (of any existing flood defences) carried out in the original Borough SFRA's based on any new flood modelling and mapping available.

The key flood risk locations are those places within the Legacy Corporation area that substantially fall within Flood Zone 3 and are shown in Figure 1. The three area based Supplementary Planning Documents are for Hackney Wick, Bromley-by-Bow and Pudding Mill.

2 Description of Study Area

The area being considered for this report is within the LLDC boundary, and a number of site allocations within this boundary are the particular focus of study. These are considered the key flood risk locations because they substantially fall within Flood Zone 3, these areas have been agreed with LLDC. They are:

- SA 1.1 Hackney Wick Station Area
- SA 1.2 Hamlet Industrial Estate
- SA 1.3 Hepscott Road
- SA 1.4 Bream Street
- SA 3.4 Greater Carpenters District
- SA 3.6 Rick Roberts way
- SA 4.1 Bromley by Bow
- SA 4.3 Pudding Mill
- Three Mill Lane

Within the LLDC boundary there are a number of water bodies including the River Lea (aka Lee), the River Lee Navigation, City Mill River, Waterworks River, Bow Back River, Three Mills Wall River, the Prescott Channel and the Hertford Union Canal. They are a network of watercourses which connect the upstream River Lea to the Thames.

A plan of the LLDC site with its site allocations and water bodies can be seen in Figure 1, where the site allocations highlighted in red are those which will be considered in more detail.

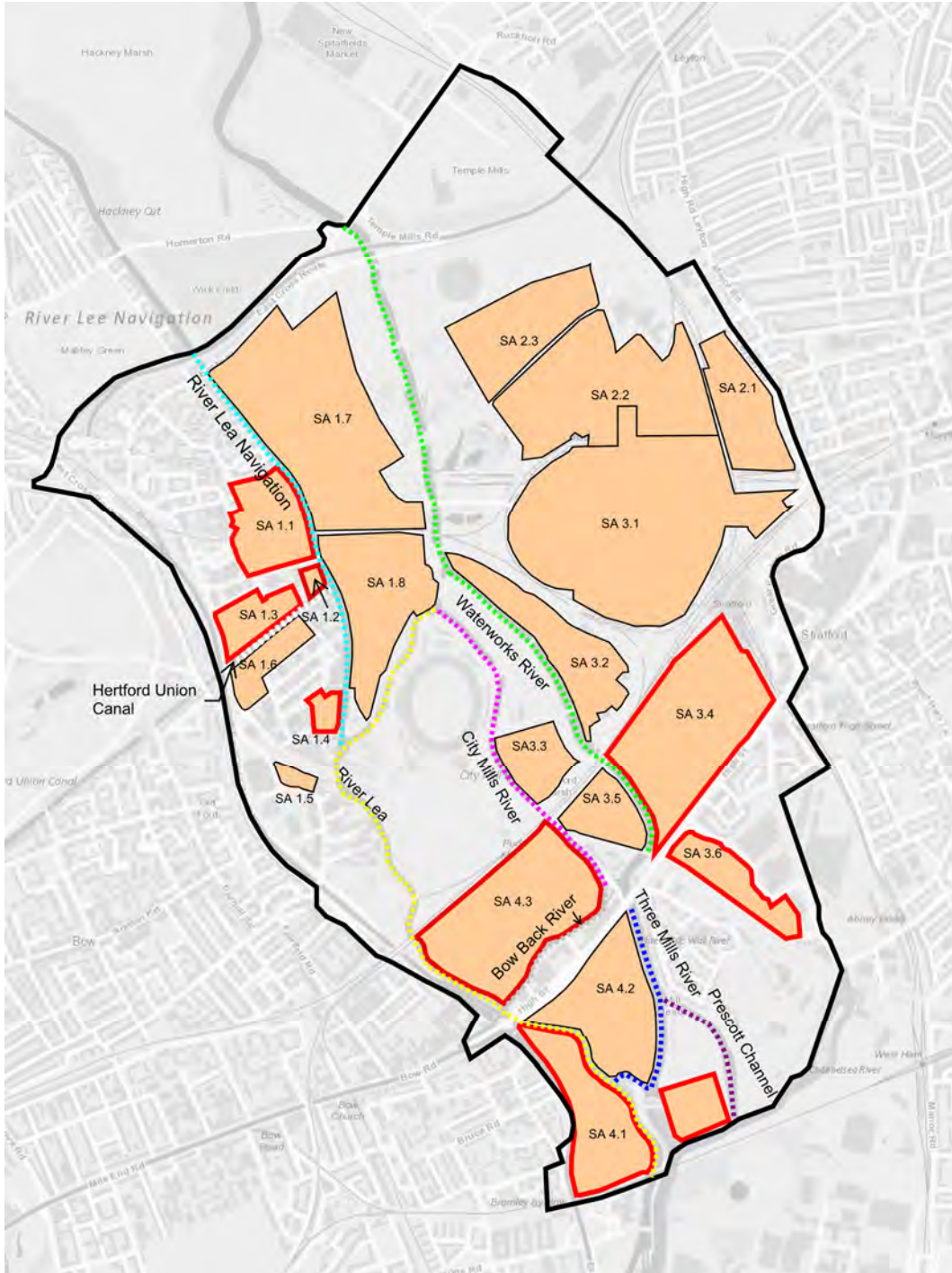


Figure 1 – LLDC Boundary with Site Allocations and Water Bodies

3 Information reviewed

3.1 Environment Agency Data

3.1.1 Flood Risk Mapping

The EA started updating their existing models of the River Lee catchment in 2010 by:

- Using more up to date hydrological data and using latest Flood Estimation Handbook (FEH) techniques
- Carrying out hydrological analysis up to the 0.1% (1 in 1000 year) Annual Exceedance Probability (AEP) event
- Using most recent LiDAR data
- Merging and rebuilding existing models
- Inclusion of new structures

Halcrow undertook the modelling of the River Lee with an aim to predict fluvial flood risk throughout the River Lee systems.

With-defences (defended) models were developed by using a combination of existing models and new surveys. These models were run for a number of design events, but in this instance we will only consider the 1 in 100 year + climate change storm results. The allowance for climate change for these models was set to 20% as this was in line with the latest EA guidance (2011) at the time of modelling. This is not in line with latest EA guidance (NPPF 2016), however there are no current plans to carry out further modelling updates to reflect this.

The outputs from this mapping used in this report are water level, hazard maps, water depth and flood outline. Comparison between the defended and undefended models enables the Areas Benefitting from Defence (ABD) to be identified. ABDs are those areas which benefit from formal defences specifically in the event of flooding from rivers with a 1% (1 in 100) chance of exceedance.

3.1.2 Historic Flood Events

From the EA data, the only historic flood event which has contributed to the Flood Event Outline Map is the 1947 storm. It must be noted however that this does not provide a definitive record of flooding.

The London Boroughs of Newham and Tower Hamlets also record a flood in 1953 which was caused by a tidal surge in the North Sea in which the River Lea was observed to break its banks. There are no records for the outline of this flooding event.

3.1.3 Flood Modelling and Hydrology Reports

Halcrow have produced modelling reports and CH2M Hill have produced a hydrology report for the updated models.

The hydrology report outlines how the hydrological assessment was updated in accordance with the latest techniques from the Flood Estimation Handbook (FEH), in summary:

Hydraulic Modelling Technical Report:

- Models were developed using the latest hydrometric and new survey data
- The hydrological flow boundaries were updated using the EAs latest hydrology guidance maps of flood risk areas
- A range of design flood events were modelled up to 0.1% Annual Exceedance Probability (AEP).
- An allowance for climate change was included for the 1% AEP to enable the identification of areas benefitting from defences
- Models were calibrated against observed flood levels, flow records at gauging stations and reality checks with the EA
- Calibration results matched well
- Key flood risk areas were identified from the defended models, those within the LLDC boundary are:
 - o Bream Street (residential and industrial buildings centring on Dace Road, to the East of A12 East Cross Route and to the west of River Lee confluence.)
 - o Hackney Wick

Hydrology Report:

- Both the FEH and ReFH were compared to determine which was the most appropriate to use for the design hydrograph
- It was concluded that existing ungauged TH687 FEH catchment inflows should be applied throughout

3.1.4 Model Output Data

Output data from the River Lee 2D flood modelling was used to determine the flood levels at key points along the River Lee and its tributaries in the vicinity of the LLDC site allocations. These locations can be seen in Figure 2 and tabulated values in Table 1. These nodal results were used to determine the Standard of Protection (SoP) provided by the defences, that is, up to which AEP storm the defence level is greater than the flood level.

Table 1 –Nodal results from Fluvial Modelling

Location	Max. 100 Year + CC Flood Level (m AOD)	Max. 1000 year Flood Level (mAOD)
Hackney Wick Station	6.29	6.35
Hamlet Industrial Estate	6.27	6.32
Hepscott Road	5.01	5.95
Bream Street	6.26	6.31
Greater Carpenters District	-	3.72 ¹
Rick Roberts Way	-	-
Pudding Mill	5.03	5.07
Bromley by Bow	5.01	5.04
Three Mills	4.69	4.93

¹ This is the flooding of the sunken rail tracks to the north of the site allocation.

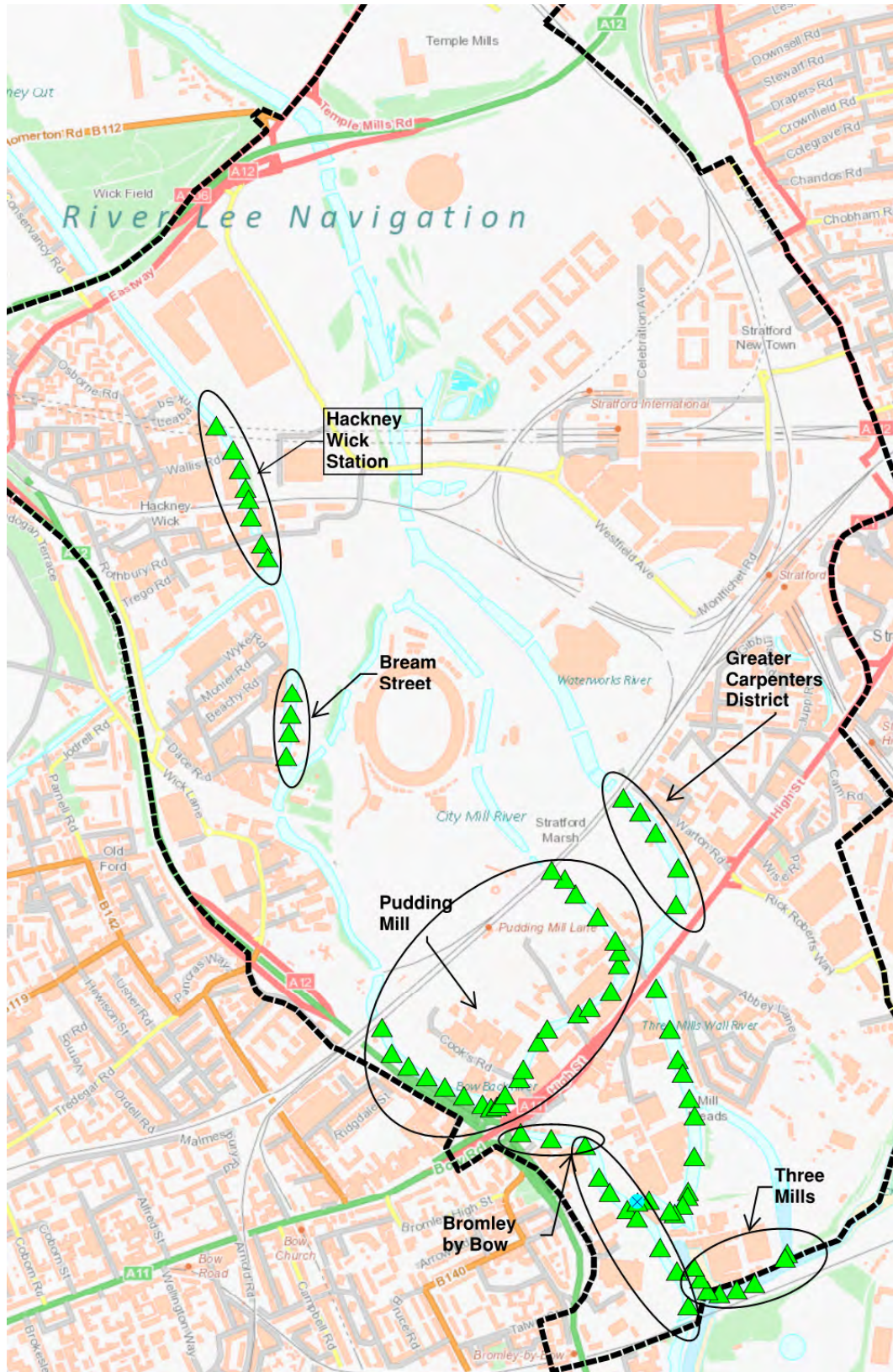


Figure 2 – Nodal locations for modelled flood levels shown in Table 1.

3.1.5 Breach Modelling and Flood Defence Breach Hazard Map

In 2014 Halcrow undertook a Thames Tidal Breach Modelling Study on behalf of the EA. It was built upon previous studies but used updated tidal water levels used to simulate breaching which were consistent with the Thames Estuary 2100 plan (TE2100).

The breach locations remain the same as previous studies and are chosen based on floodplain topography behind the flood defences and property density, i.e. the number of people that would be affected by the breach.

The breach locations in the vicinity of the LLDC can be seen in Figure 3.

The breach assessment upstream of the Thames Tidal Barrier up to the year 2100 uses the Maximum Likely Water Level (MLWL) as opposed to different return period storms. The extents of this can be seen in Figure 4.

It can be seen that the breach locations are all outside of the LLDC boundary and therefore are not always in proximity to the site allocations. Therefore if a breach were to occur at a location within the LLDC, the extent of flooding due to this breach would have a greater impact on the site allocations than that which has been modelled. It is recommended that effect of breaching of defences is considered on a site by site basis, with a breach occurring in defences in the vicinity of each site, when carrying out site specific FRAs.



Figure 3 – Breach locations for Thames Tidal Breach Modelling Study.



Figure 4 – Thames Tidal Breach Modelling Flood Extents with LLDC Site Allocations

3.2 National Planning Policy Framework (NPPF) – Planning Practice Guidance (PPG) (2014)

3.2.1 Climate Change Allowance

As of 19th February 2016, guidance within the NPPF on the approach taken to climate change allowances when undertaking FRAs was updated.

These allowances for climate change apply to peak river flow by river basin district, peak rainfall intensity, sea level rise and offshore wind speed and extreme wave height. They help to minimise vulnerability and provide greater resilience to flooding and coastal change in the future.

The climate change allowance for peak rainfall intensity depends on the proposed land use, design life of the development and the Flood Zone. In a similar way to the Sequential Test (PPG), the chosen intensity depends on the vulnerability classification as defined by Table 2 (described in Section 3.2.2) of the Flood Zone and Flood Risk Tables in PPG.

The range of allowances are based on percentiles, which describes the proportion of possible scenarios that fall below an allowance level i.e. the 50th percentile is the point at which half of the possible scenarios for peak rainfall intensity fall below it and half fall above it. The:

- Central allowance is based on the 50th percentile
- Higher Central is based on the 70th percentile
- Upper end is based on the 90th percentile

When carrying out flood risk assessments and strategic flood risk assessments, both the central and upper end allowances should be applied to peak rainfall intensity and assessed in order to understand the range of impact. The percentile allowance applied to peak river flow depends on the vulnerability classification of the land use. These will be defined for each specific site. The percentage allowances can be seen in Table 2, Table 3, and Table 4.

These tables refer to a number of epochs, which is relevant to the design life of the development. All residential developments will have at least a 100 year design life in accordance with PPG, other land uses are assumed to have at least a 60 year design life, however this may vary depending on the characteristics of the development. Therefore, only the third column needs to be considered in Table 2 and Table 4 because 2070 occurs before the 60 year design life. Sea level rise values will need to be considered on a more individual basis.

Where two values are given for climate change allowance, they must both be considered to understand the range of impact the allowances have. The upper end is usually used as a sensitivity test for access and egress routes for example.

Table 2 – Peak rainfall intensity allowance in small and urban catchments.

Percentile	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 3 – Sea level allowance for each epoch in millimetres per year with cumulative sea level rise for each epoch in brackets (since 1990 baseline).

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

Table 4 – Peak river flow allowances by river basin district (using 1961 to 1990 baseline) for the Thames River basin district.

River Basin District	Allowance Category	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)
Thames	Upper End	25%	35%	70%
	Higher Central	15%	25%	35%
	Central	10%	15%	25%

The updated EA Flood Maps do not take into account the new guidance for climate change as described above. This will need to be accounted for when site specific flood risk assessments are being carried out.

3.2.2 The Sequential and Exception Tests

The objective of the Sequential and Exception approach to flood risk assessment is to steer development away from high flood risk areas by considering other reasonable available sites which are either in Flood Zone 1 or 2.

These methods are risk based approaches to ensure development is either directed away from areas most at risk of flooding, or control the risk should no other areas be available or suitable for development.

The updated tests will be carried out in Sections 4, 5 and 6.

Land uses are classified by their vulnerability as follows:

Essential Infrastructure:

- Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk.
- Essential utility infrastructure which has to be located in a flood risk area for operational reasons, including electricity generating power stations and grid and primary substations; and water treatment works that need to remain operational in times of flood
- Wind turbines.

Highly Vulnerable:

- Police and ambulance stations; fire stations and command centres; telecommunications installations required to be operational during flooding
- Emergency dispersal points
- Basement Dwellings
- Caravans, mobile homes and park homes intended for permanent residential use.
- Installations requiring hazardous substances consent. (Where there is a demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities, or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water-side locations, or need to be located in other high flood risk areas, in these instances the facilities should be classified as ‘Essential Infrastructure’).

More Vulnerable:

- 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:

- Police, ambulance and fire stations which are not required to be operational during flooding.
- Buildings used for shops; financial, professional and other services; restaurants, cafes and hot food takeaways; offices; general industry, storage and distribution; non-residential institutions not included in the 'More Vulnerable' class; and assembly and leisure.
- Land and buildings used for agriculture and forestry.
- Waste treatment (except landfill² 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.
- Sewage treatment works, if adequate measures to control pollution and manage sewage during flooding events are in place.

Water Compatible Development:

- Flood control infrastructure
- Water transmission infrastructure and pumping stations.
- Sewage transmission infrastructure and pumping stations.
- Sand and gravel working.
- Docks, marinas and wharves.
- Navigation facilities.
- Ministry of Defence defence installations.
- Ship building, repairing and dismantling, dockside fish processing and refrigeration and compatible activities requiring a waterside location.
- Water-based recreation (excluding sleeping accommodation).
- Lifeguard and coastguard stations.
- Amenity open space, nature conservation and biodiversity, outdoor sports and recreation and essential facilities such as changing rooms.
- Essential ancillary sleeping or residential accommodation for staff required by uses in this category, subject to a specific warning and evacuation plan

These vulnerability classifications are used within the Sequential Tests in Sections 4, 5 and 6.

² * Landfill is as defined in Schedule 10 to the Environmental Permitting (England and Wales) Regulations 2010.

3.3 Environment Agency Advice on Flood Modelling

Hertfordshire and North London Area department of the EA have published a guidance document (*Flood risk assessments: Climate change allowances, application of the allowances and local considerations*) describing how the new climate change allowances would need to be applied for FRAs. Depending on the type and scale of development, varying levels of detail of assessment need to be carried out.

Development scales are defined as:

- Minor:
 - o 1-9 Dwellings/ less than 0.5ha
 - o Office/ Light industrial under 1ha
 - o Retail under 1 ha
 - o Gypsy/ Traveller sites between 0 and 9 pitches

- Small-Major:
 - o 10-30 Dwellings
 - o Office/ Light industrial 1ha to 5ha
 - o General Industrial 1ha to 5ha
 - o Retail over 1ha to 5ha
 - o Gypsy/ Traveller site over 10 to 30 pitches

- Large- Major:
 - o 30+ dwellings
 - o Office / Light industrial 5ha+
 - o General industrial 5ha+
 - o Retail 5ha+
 - o Gypsy/ Traveller site over 30+ pitches
 - o Any other development that creates a non-residential building or development over 100 sq m

The two types of assessment are defined as ‘intermediate’ or ‘detailed’. Intermediate assessment requires the developer to use existing modelled flood and flow data to create a stage-discharge rating curve. This can then be used to interpolate a flood level using the peak flow climate change allowances and determining the corresponding stage (flood level).

Detailed assessment requires detailed hydraulic modelling to be undertaken by either re-running EA hydraulic models (if available) or construction of a new model by the developer. Guidance on the level of detail of assessment required is shown in Table 5.

Table 5 – Guide to flood risk assessment approach for developments, from EA guidance document

Vulnerability Classification	Flood Zone	Development Type		
		Minor	Small-Major	Large-Major
Essential Infrastructure	Zone 2	Detailed		
	Zone 3a	Detailed		
	Zone 3b	Detailed		
Highly Vulnerable	Zone 2	Intermediate	Intermediate	Detailed
	Zone 3a	Not Appropriate Development		
	Zone 3b	Not Appropriate Development		
More Vulnerable	Zone 2	Intermediate	Intermediate	Intermediate
	Zone 3a	Intermediate	Detailed	Detailed
	Zone 3b	Not Appropriate Development		
Less Vulnerable	Zone 2	Intermediate	Intermediate	Intermediate
	Zone 3a	Intermediate	Intermediate	Detailed
	Zone 3b	Not Appropriate Development		
Water Compatible	Zone 2	None		
	Zone 3a	Intermediate		
	Zone 3b	Detailed		

3.4 Strategic Flood Risk Assessments

3.4.1 London Borough of Hackney

Hackney carried out their Level 2 SFRA in September 2010, which was an increase in scope from their Level 1 SFRA to enable the application of the Planning Policy Statement 25 (PPS25) Exception Test and to inform local planning documents, in particular the (AAP) for Hackney Wick.

The SFRA focuses heavily on the Hackney Wick area due it being at actual risk of flooding with modelled depths up to 2m and Hazard Classifications of ‘Significant (Danger for most)’ and ‘Extreme (Danger for all)’.

Specific guidance given in this assessment includes:

- PPS25 Tests should be applied and a sequential approach to land use allocation within sites should be followed, ensuring more vulnerable land uses are located in areas of lowest risk
- Compensatory floodplain storage for the 1 in 100 year AEP storm flood level + climate change should be provided where building footprints have increased or where ground levels are elevated to raise the development above the flood level.
- Safe access and egress or safe refuge must be provided during a flood event, the levels of which will be determined by flood depth information
- Basement dwellings are not permitted in Flood Zone 3 and must pass the Exception Test in Flood Zone 2.

- An 8-16 m undeveloped buffer must be provided alongside rivers and developers must explore opportunities for river restoration as part of any development.

Within the Borough is the River Lee Flood Relief Channel, which was constructed in the 1970s. This channel has almost reached its 1 in 70 year capacity three times since construction and thus highlighting that there is a real flood risk to the area.

3.4.2 London Borough of Tower Hamlets

LBTH updated their SFRA in November 2016. The updated report ensures compliance with the NPPF, PPG and guidelines from the EA. It is using the most up to date flood risk information from all sources, and the advice given is intended to inform the emerging Local Plan.

The key recommendations for policy and practice within this report relative to fluvial flood risk are:

- Undertake Sequential and Exception Tests where necessary
- Pursue opportunities to consider the vulnerability of existing developments and whether there is potential for land swap with lower vulnerability uses.
- Create space for water by locating and designing development appropriately, accommodating for climate change and managing future flood risk
- Consider a combination of defence realignment and floodplain management to reduce the impact of flooding on existing properties
- Promote setting back of development, enabling sustainable flood risk management including upgrading of defences.
- Single storey residential development and basement dwellings should not be considered in areas of high flood risk
- Residual risks such as breaching should be managed through effective emergency planning, site design and protection measures

3.4.3 London Borough of Waltham Forest

The site allocations being considered in this report do not fall within LB of Waltham Forest.

3.4.4 London Borough of Newham

Newham last published their SFRA in May 2010, however they are in the process of updating this in light of recent policy changes. In the current SFRA, the main policy recommendations relating to fluvial flooding are:

- 8-16 metre wide undeveloped buffer strip alongside river corridors

- Presumption against further culverting
- Maximise opportunities to deculvert/ undertake river restoration.
- Ensure Sequential Test has been undertaken where necessary
- Development does not increase flood risk by providing level for level floodplain compensation
- Site is designed sequentially by avoiding placing buildings within the natural floodplain
- Opportunities to locate water compatible development to Flood Zone 2 and 3 and move vulnerable development to Flood Zone 1 should be maximised.
- The Council should seek measures to reduce flood risk by considering:
 - o Making lengths of the flood defence 'unbreachable'
 - o Introduce secondary defences through a strategic approach
 - o Site specific secondary defences
 - o Use lower vulnerability land uses around perimeter of a development to act as a secondary flood defences to higher vulnerability development within the centre.

They have applied their own 'Breach Capture' methodology to assess the effect of breaching of flood defences across the Borough in the absence of breach modelling for the large number of raised defences and watercourses. The method transposes the levels along the River Lea and River Roding perpendicularly across the flood plain and thus showing the potential extents of flooding due to a breach. This is a conservative estimate because the levels used within the rivers are those of a constrained channel and in reality may be lower over the floodplain. The effects of climate change are also ignored in this analysis. This type of breach analysis may be more useful than the EA modelling (shown in Figure 5) in this area because it accounts for breaching of defences close in proximity to the site, however the modelling methodology is less accurate.

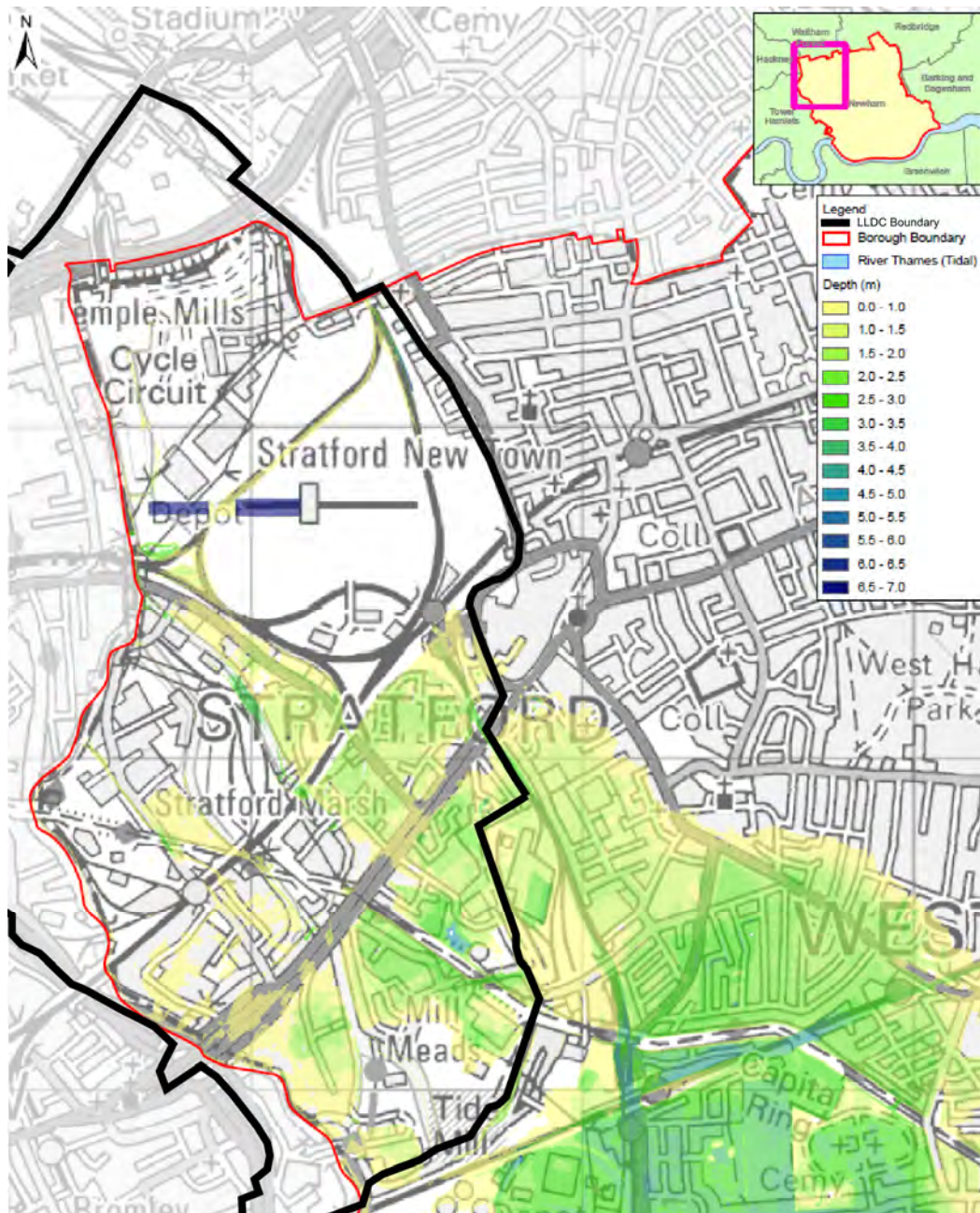


Figure 5 – Tidal defence breach map included as Figure 5.2A in the Newham’s SFRA.

3.4.5 Key Findings

The three SFRA’s which have been reviewed have highlighted a number of key points:

- A site specific FRA must be undertaken in accordance with PPS25
- All development must carry out land use allocation in a sequential approach, directing high vulnerability sites away from high flood risk areas and vice versa.

- Certain measures should be put in place where more vulnerable land uses are located in high flood risk areas. These measures are based on guidance from the EA. They include:
 - Safe access egress must be provided at a level suitable to the type of development
 - Flow routes must be preserved and floodplain storage capacity must not be reduced
 - In areas of fluvial flood risk, habitable finished floor levels (FFLs) should be 300mm above the 1% AEP plus climate change flood level or 600mm above the 1% AEP flood level.
 - In areas at risk of a breach of tidal defences, habitable FFLs must be raised 300mm above the maximum water level caused by a breach during the 0.5% AEP plus climate change storm.
 - Ensure there is an 8-16m wide undeveloped strip beside rivers
 - Opportunities to reduce the size of the footprint of buildings are considered
 - In areas of flood risk (i.e. Zone 2 and 3), there must be no basement dwellings
 - Resilience measures for existing ground floor residential units within flood risk zones must be put in place and FFLs must be raised where possible
 - Resilience measures must also be incorporated into proposed ground floor developments

3.5 LLDC Local Plan

3.5.1 Sub Area 1: Hackney Wick and Fish Island

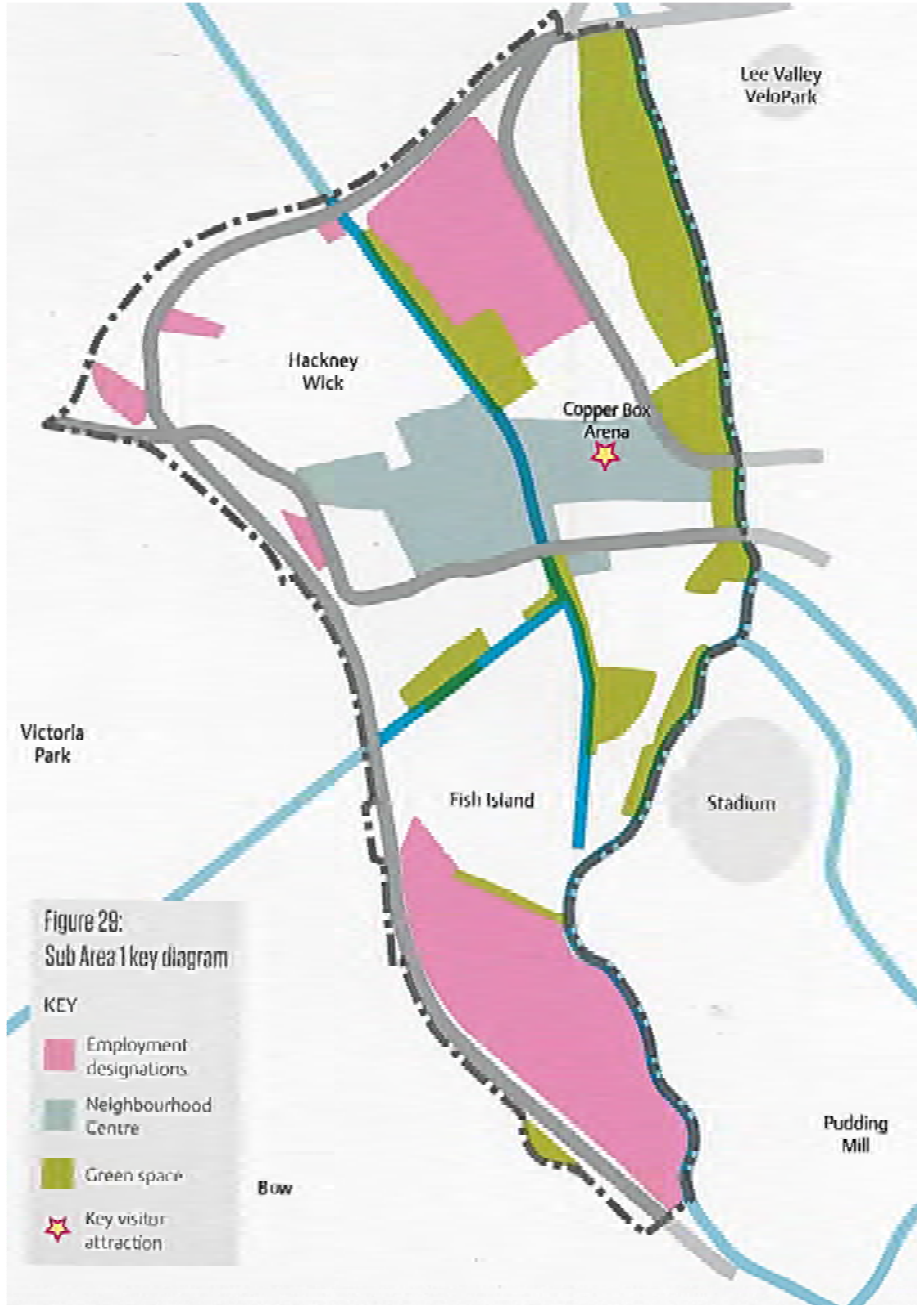


Figure 6 – Land use distribution within SA1 for Hackney Wick and Fish Island, Figure 29 from LLDC Local Plan.

In the land use distribution shown in Figure 6, it can be seen that employment designations (purple) will be situated mainly to the north of the Copper Box Arena and to the south of Fish Island. The area surrounding Hackney Wick Station is where the Neighbourhood Centre will be, along with that surrounding the Copper Box. Green Spaces are mainly limited to water frontages.

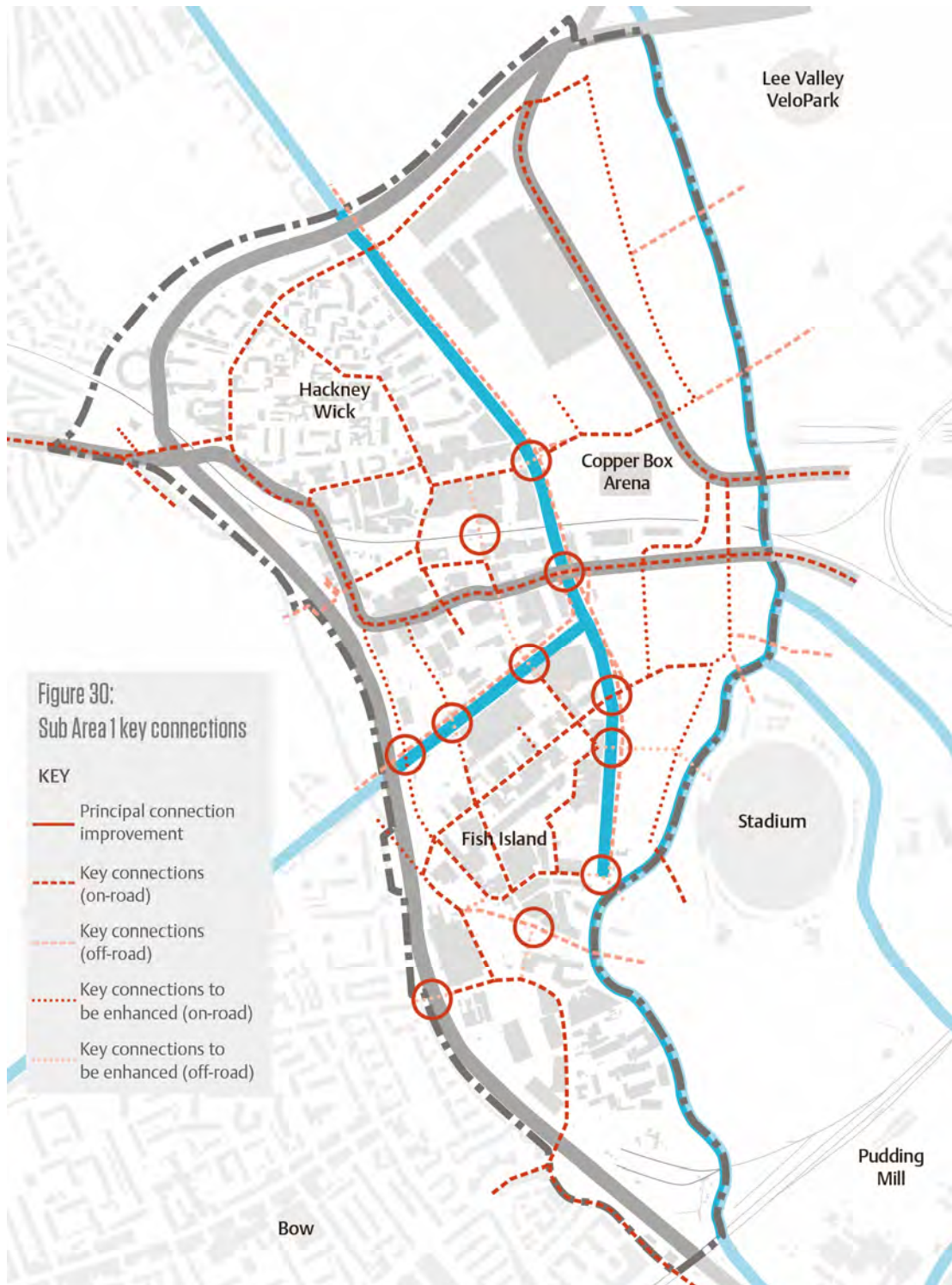


Figure 7 – Key Connections within Hackney Wick and Fish Island from Figure 30 of the LLDC Local Plan

Figure 7 shows where new river or canal crossings may be constructed or existing crossings may be altered or improved. This is important with regards to fluvial flood risk as a full flood impact assessment must be carried out for any of these works.

3.5.2 Sub Area 3: Greater Carpenters District and Rick Roberts Way

Within Sub Area 3 of the LLDC Local Plan, this study focuses only on Greater Carpenters District (SA 3.4) and Rick Roberts Way (SA 3.6). The Metropolitan Centre and the Stratford High Street policy area extends to the north of SA 3.4.

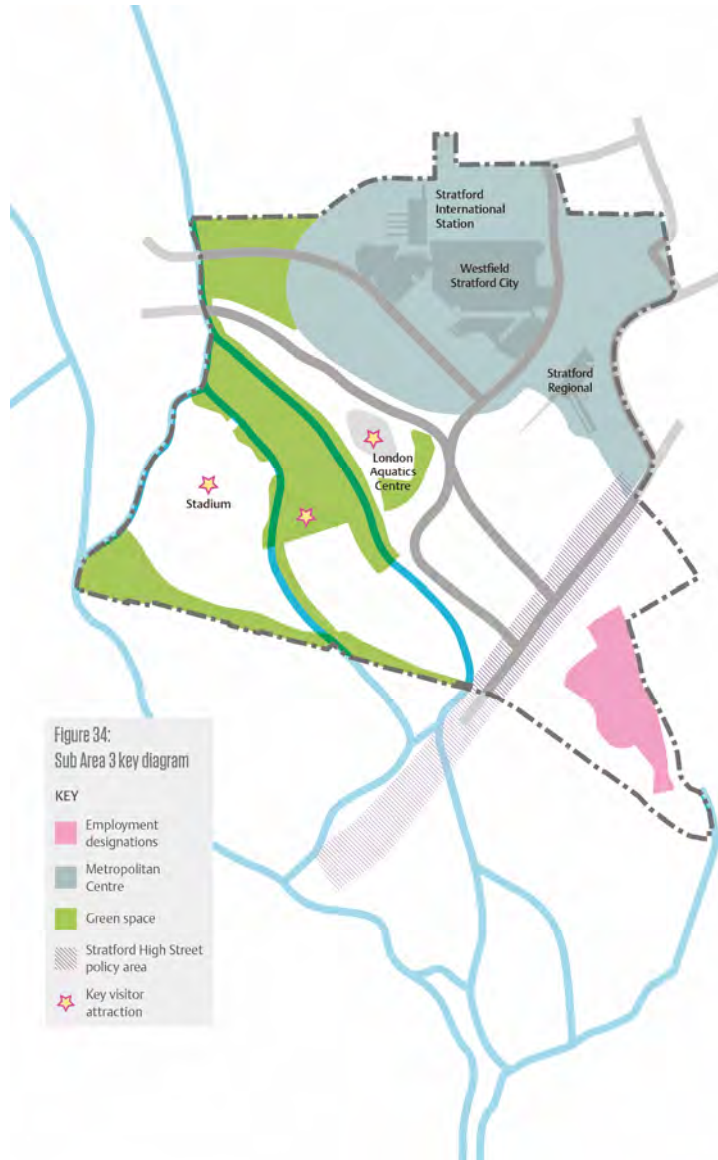


Figure 8 – Land use distribution within SA3 from LLDC Local Plan Figure 34.

3.5.3 Sub Area 4: Bromley-by-Bow, Pudding Mill, Sugar House Lane and Mill Meads

Sub Area 4 within the LLDC Local Plan includes those areas listed above. In this study however the focus is only on Bromley-by-Bow and Pudding Mill.

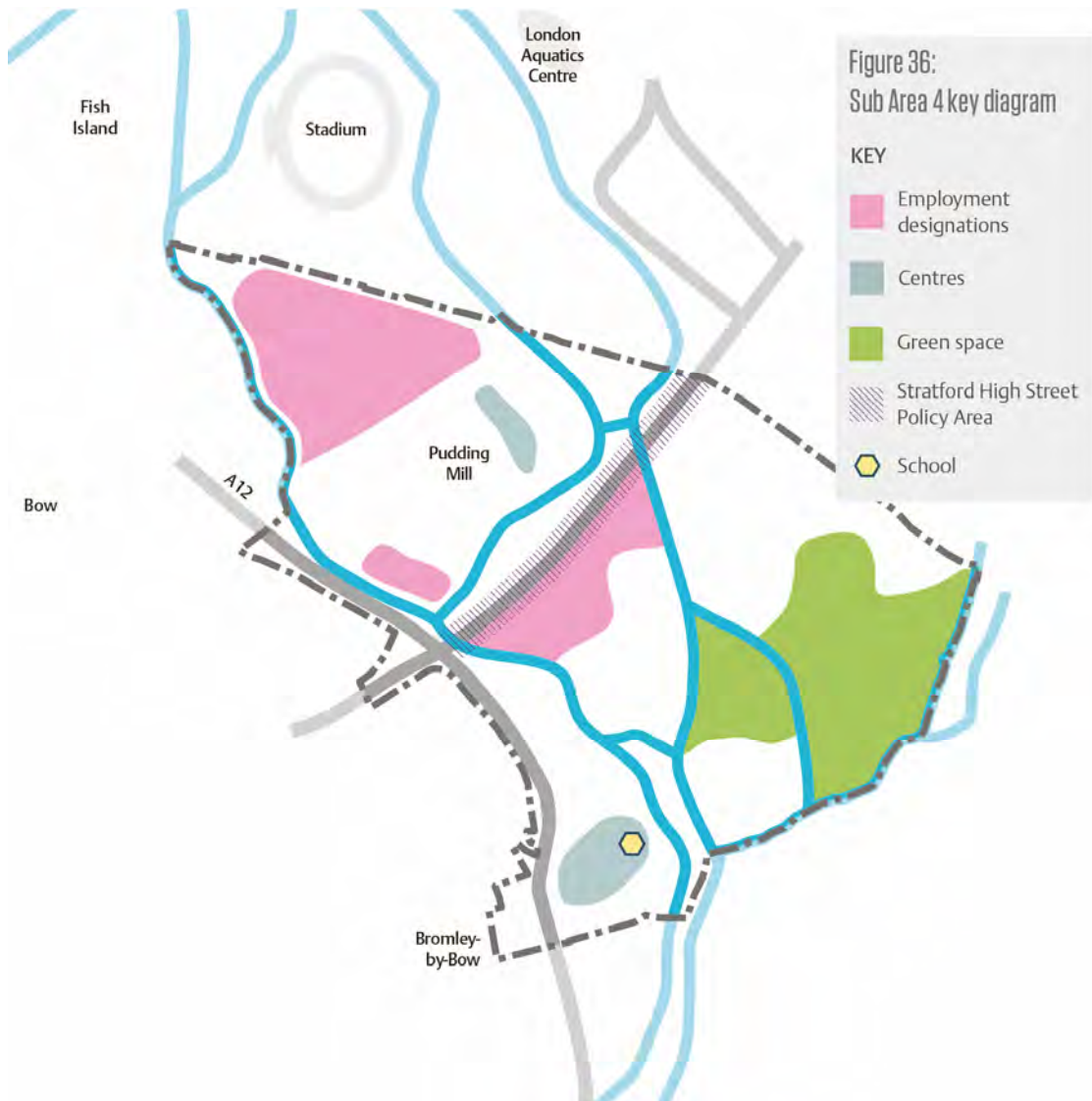


Figure 9 – Land use distribution within SA4 for Bromley-by-Bow, Pudding Mill, Sugar House Lane and Mill Meads. Figure 36 from the LLDC Local Plan.

The LLDC Local Plan shows that the majority of employment designations will be situated to the north of the Sub Area, to the south of Stratford High Street and within Pudding Mill. Neighbourhood Centres are proposed to the south of Bromley-by-Bow, which also includes a school, and within Pudding Mill.

Principal connection improvements are proposed which include new crossings over the River Lee as shown in Figure 10. Any of these new crossings will need to fully assess the impact on upstream flooding.

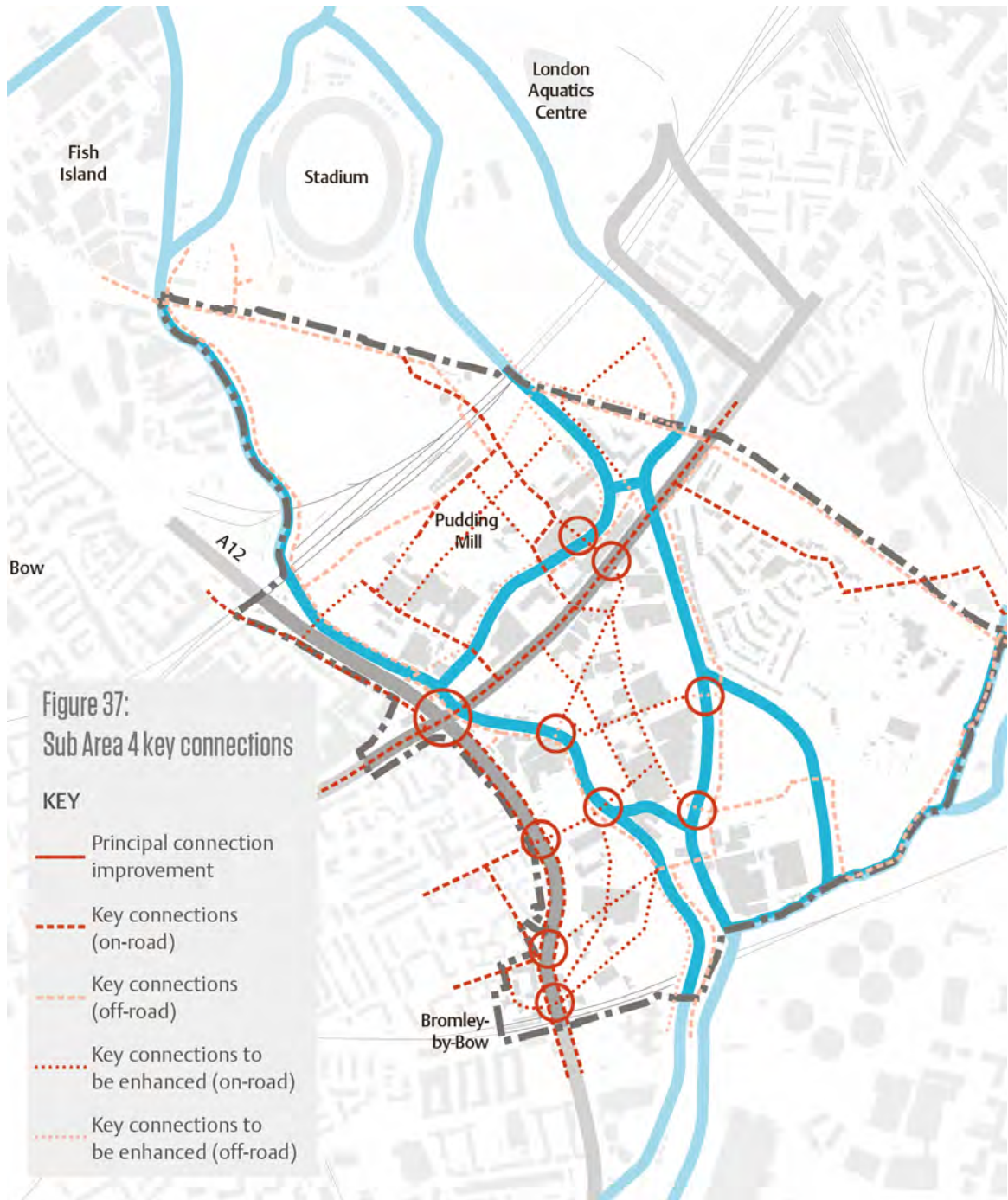


Figure 10 – Connection improvement diagram for Sub Area 4 Bromley-by-Bow. From LLDC Local Plan Figure 37.

4 Hackney Wick and Fish Island Flood Risk

The development of Sub Area 1 will see approximately 2,500 new homes in the next 15 years and a further 2,000 which already have planning permission. The developments will mainly be mixed use, with leisure, retail, community and education facilities.

4.1 SA 1.1 Hackney Wick Station

This area is within the LB Hackney and has the raised rail track running through it with Hackney Wick Station located within the site. To the east of this area is the River Lee Navigation. The proposed development of this area includes a significant number of new homes, new retail, leisure, food /drink and community facilities. The bridge crossing the River Lee Navigation on White Post Lane and the footbridge to the east of Wallis Road are marked for improvement.

4.1.1 EA Flood Risk Maps and Data

As can be seen in Figure 11, the majority of the Hackney Wick Station area lies within a Flood Zone 3 (FZ 3) containing both undefended areas and ABDs. The flooding has become more severe on the site as previous Flood Zone 2 (FZ 2) areas are now FZ 3. Though, the areas undefended from flooding appear to be limited to Berkshire Road, Wallis Road and Hepscott Road. Some areas adjacent to the River Lee Navigation also do not benefit from flood defences.

The model for the 1 in 100 year +20% Climate Change defended flood levels within the Hackney Wick Station area are between 5.01m AOD and 5.5mAOD.



Figure 11 – Flood Zone Map for Site Allocation 1, Hackney Wick and Fish Island.

4.1.2 Sequential and Exception Test

The Sequential and Exception Tests for Hackney Wick Station.

Table 6 – Development Compatibility and Flood Assessment Level (as per Section 3.3) for Hackney Wick Station

Proposed Land Use	Flood Zone	Vulnerability Classification	Compatibility	Flood Assessment Level
Residential	Developable area all Flood Zone 3, most are ABDs.	More Vulnerable	Sequential Test Required	Intermediate ³
Community uses		More Vulnerable	Sequential Test Required	Detailed
Retail & Leisure		Less Vulnerable	OK	Intermediate
Employment/ Business Space		Less Vulnerable	OK	Intermediate
Conclusion:	Sequential Test for the Hackney Wick site concludes that there are no alternative sites available for development that are capable of delivering this number of new homes as required by the London Plan. Therefore the Hackney Wick Station area (SA1.1) passes the Sequential Test, but must also be subjected to the Exception Test. Detailed hydraulic modelling will need to be carried out for residential and community use spaces.			

Table 7 – Sequential Test for Hackney Wick Station

Stage in Sequential Test	Assessment
Can development be allocated in a lower risk Flood Zone?	The development may be located within FZ2 if the small areas of FZ3 are allocated as open space or other water compatible land uses. All identified site allocations within the LLDC area whether in FZ 1, 2 or 3 are required in order to meet these London Plan targets.
Conclusion:	There are no other suitable ‘opportunity’ sites within the LLDC area.

³ It is assumed there will be less than 0.5ha of residential development if the land use allocations shown in Figure 6 are still valid. Exceeding this, a detailed flood assessment will need to be carried out.

Table 8 – Exception Test for Hackney Wick Station

NPPF Requirement	Response
It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by an SFRA where one has been prepared.	There is potential for new homes and employment within the site, with the focus being on employment land uses. The site is brownfield land and has previously been marked for redevelopment and regeneration and is part of a wider Hackney Wick and Fish Island regeneration plan.
A site specific Flood Risk Assessment must demonstrate that the development will be safe for its lifetime, taking account of the vulnerability of its users, without increasing flood risk elsewhere and, where possible, will reduce flood risk overall.	A site specific FRA will be required for each development proposal, taking into account the most up to date flood risk information and following the recommendations of the Hackney SFRA. These recommendations can be seen in Section 3.4.1.
Conclusion:	An appropriate site layout and a site Specific FRA in compliance with Newham's SFRA will ensure the NPPF requirements of the second part of the Exception Test are met and therefore the Exception Test is passed.

4.1.3 Updated Breach Assessment

The Thames Tidal Breach Assessment carried out by the EA has the closest modelled breach location over 2km from the site. The extents of the flooding from this breach to not reach the site. This is insufficient evidence to conclude that a breach of flood defences would not affect Hackney Wick, and therefore a local breach must be considered on a site by site basis as part of the flood risk assessment.

4.1.4 Climate Change Allowances

Table 9 - Climate Change Allowances as per Section 3.2.1 for Hackney Wick

% increase allowance	Peak Rainfall Intensity	Peak River Flow	
		Flood Zone 2	Flood Zone 3
Residential	20% and 40%	25% and 35%	35% and 70%
Community Uses	20% and 40%	25% and 35%	35% and 70%
Retail and Leisure	20% and 40%	25%	25% and 35%
Employment/ Business Space	20% and 40%	25%	25% and 35%

4.1.5 Flood Risk Guidance

The advice provided within the SFRA for LB Hackney should be followed:

- PPS25 Tests should be applied and a sequential approach to land use allocation within sites should be followed, ensuring more vulnerable land uses are located in areas of lowest risk
- Compensatory floodplain storage for the 1 in 100 year AEP storm flood level + climate change should be provided where building footprints have increased or where ground levels are elevated to raise the development above the flood level.
- Safe access and egress or safe refuge must be provided during a flood event, the levels of which will be determined by flood depth information
- Basement dwellings are not permitted in Flood Zone 2 and 3
- Mixed use developments which are located in flood risk zones should have residential aspects located on upper levels above flood levels
- An 8-16 m undeveloped buffer should be provided alongside rivers to ensure maintenance of the channel can be undertaken
- Developers should explore opportunities for river restoration and enhancement as part of any development adjacent to a river or watercourse
- Any hazardous substances should be stored above flood level
- Assessment of single storey residential properties should be undertaken to ensure they are protected from flooding and any flood proofing measure should be implemented where possible in order to reduce the costs and consequences of a flood event.
- Flood evacuation procedures for those within Hackney Wick should be considered
- It is recommended that all new development is restricted to Greenfield runoff rate and surface water drainage design is carried out by following the SuDS hierarchy as described in the SuDS Manual (CIRIA 2015)
- Finished floor levels should be set in accordance with EA guidance, assessed on a site by site basis, and should comply with the Latest LLDC Local Plan Flood Risk and Sustainable Drainage Measures Policy.

4.2 SA 1.2 Hamlet Industrial Estate

This site lies within the LB of Tower Hamlets and is proposed to be a mixed use development with employment and residential floor space with restaurants and cafes. The River Lee Navigation bounds the east of the site and the Hertford Union Canal bounds the south. Access to the tow path adjacent to the River Lee Navigation is proposed to be improved with green space being provided on the southern edge of the site.

4.2.1 EA Flood Risk Maps and Data

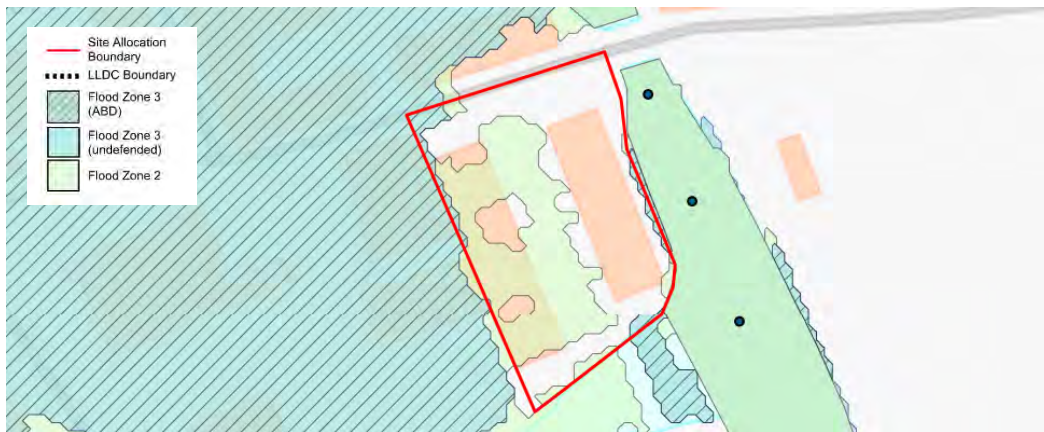


Figure 12 – EA Flood Map for the Hamlet Industrial Estate Site Allocation

As shown in Figure 12, a large portion of the site lies within FZ 2, small areas on the eastern and western peripheries lie within FZ 3 but the majority is within Flood Zone 1 (FZ 1). This shows a reduction of the extent of flooding from the previous maps which showed the site to be almost entirely within FZ 2. The FZ 3 areas are ABDs and therefore there is only a residual risk of flooding from a breach in defences.

The nodal results from the fluvial 1 in 100 year+20% climate change defended model show that Hamlet Industrial Estate does not flood.

4.2.2 Sequential and Exception Tests

Table 10 – Development Compatibility and Flood Assessment Level (as per Section 3.3) for Hamlet Industrial Estate

Proposed Land Use	Flood Zone	Vulnerability Classification	Vulnerability and Compatibility	Flood Assessment Level
Residential	Flood Zones 1, 2 and 3. FZ 3 only along far eastern and western edges. Majority FZ 1.	More Vulnerable	Development Permitted (avoiding Z3)	Intermediate
Business/ Employment Space		Less Vulnerable	Development Permitted	Intermediate

Conclusion:	Development permitted provided residential development avoids the small areas of FZ3. If development is kept within FZ1 and 2, the flood risk assessment will need an intermediate level of detail as described in Section 3.3.
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Table 11 – Sequential Test for SA 1.2 Hamlet Industrial Estate

Stage in Sequential Test	Assessment
Can development be allocated in a lower risk Flood Zone?	The residential development may be steered towards areas within the site which are with FZ1, however this would largely depend on the masterplan requirements. The development may be located within FZ2 if the small areas of FZ3 are allocated as open space or other water compatible land uses. All identified site allocations within the LLDC area whether in FZ 1, 2 or 3 are required in order to meet these London Plan targets.
Conclusion:	The majority of the site falls within FZ1, a large portion FZ2 and very small areas of FZ3. If residential development is directed away from FZ3 then an Exceptions Test is not required.

4.2.3 Updated Breach Assessment

The breach assessment carried out was for a finite number of breach locations. The closest of which to this site is 'DOK10', which is approximately 2km away, shown in Figure 13. The extents of this breach do not reach the site. This is insufficient evidence to conclude that a breach of flood defences would not affect the site, and this must be considered on an individual development basis as part of the site specific flood risk assessment.

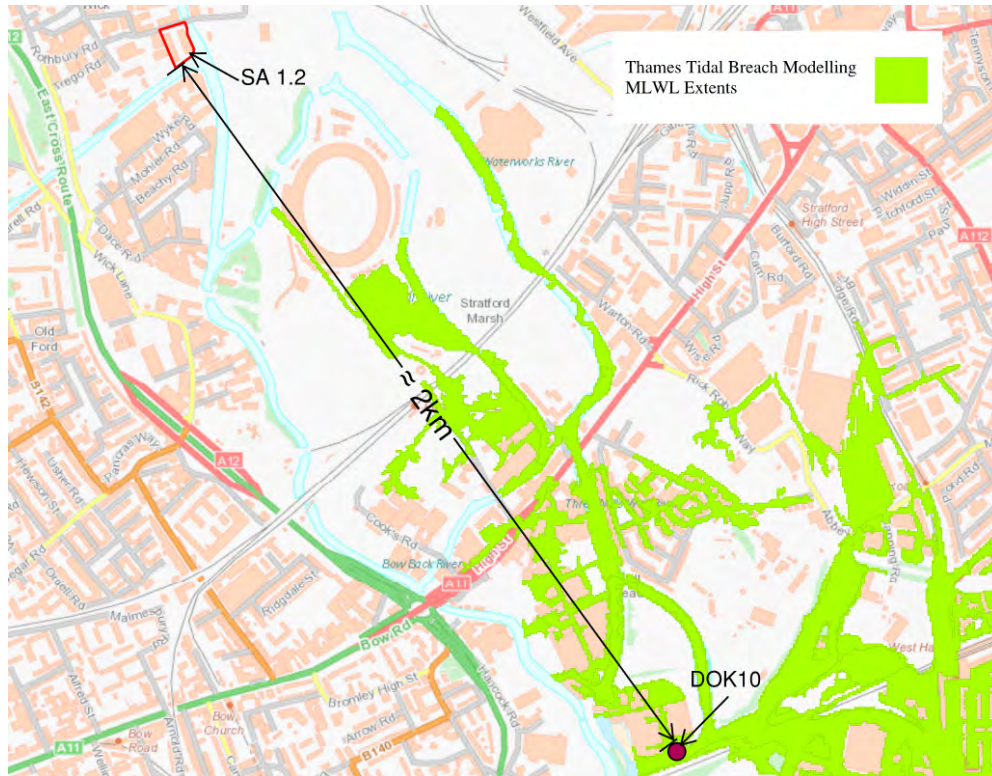


Figure 13 – Diagram showing extents of defence breach from EA modelling and location of breach relative to SA 1.2.

4.2.4 Climate Change Allowances

Table 12 - Climate Change Allowances as per Section 3.2.1 for Hamlet Industrial Estate

% increase allowance	Peak Rainfall Intensity	Peak River Flow	
		Flood Zone 2	Flood Zone 3
Residential	20% and 40%	25% and 35%	35% and 70%
Employment/ Business Space	20% and 40%	25%	25% and 35%

4.2.5 Flood Risk Guidance

Residential development should be avoided on the eastern and north-western edges of the site within FZ 3 as this can be avoided without much interference to the overall masterplan and will therefore adhere to the sequential approach to land use allocation. However, where this is not possible, resilience measures should be put in place which have been outlined in the Tower Hamlets SFRA and can be summarised as follows:

- Undertake Sequential and Exception Tests where necessary in accordance with PPS25

- Pursue opportunities to consider the vulnerability of existing developments and whether there is potential for land swap with lower vulnerability uses.
- Create space for water by locating and designing development appropriately, accommodating for climate change and managing future flood risk
- Consider a combination of defence realignment and floodplain management to reduce the impact of flooding on existing properties
- Promote setting back of development, enabling sustainable flood risk management including upgrading of defences.
- Single storey residential development and basement dwellings should not be considered in areas of high flood risk
- Residual risks such as breaching should be managed through effective emergency planning, site design and protection measures
- The use of open spaces to make space for water during times of flooding should be maximised
- There are to be no basement dwellings within Flood Zone 2 or 3 including the excavation of basements under existing dwellings
- Where development is adjacent to (within 16 metres of) the River Lee Defences, the TE2100 plan recommends that current and future flood risk is reduced through:
 - o Raising existing defences
 - o Demonstrating provision of improved access to existing flood defences
 - o Maintain, enhance or replace flood defences to provide adequate protection for the lifetime of the development
 - o On-site provision of or financial contributions towards the provision of flood risk management infrastructure should be secured to protect the development over its lifetime.
- Emergency planning strategies should be put in place for areas deemed at actual risk of flooding.
- Any new or improved canal crossing should fully assess the impact on any upstream flooding.
- Finished floor levels should be set in accordance with EA guidance, assessed on a site by site basis, and should comply with the Latest LLDC Local Plan Flood Risk and Sustainable Drainage Measures Policy.

4.3 SA 1.3 Hepscott Road

This development is located within LB Tower Hamlets and will consist of mixed use development including employment, residential, creative and cultural uses and a park adjacent to the Hertford Union Canal on the south edge of the site. It is proposed to include new and/or improve existing canal crossings.

4.3.1 EA Flood Risk Maps and Data

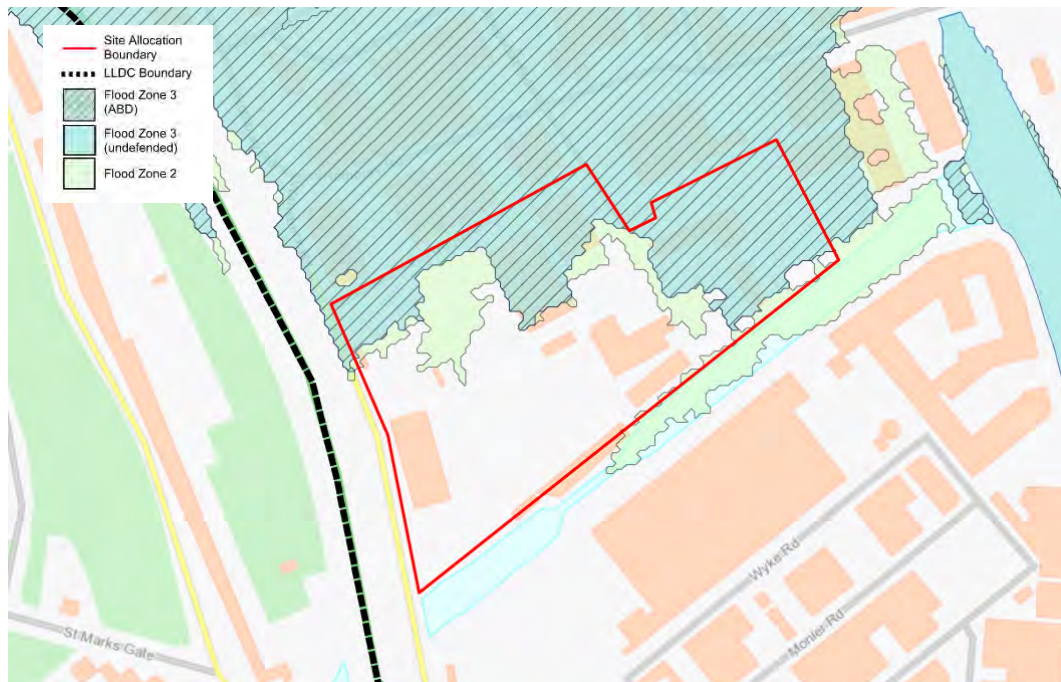


Figure 14 – EA Flood Map for the Hepscott Road Site Allocation

The majority of the site lies within FZ1, with a large portion of FZ3 and some FZ2. The flooding is worse than was shown by the previous Flood Maps in which there was only FZ1 and FZ2. However, the FZ3 areas are ABDs and so there is only a residual risk of flooding which would occur from a breach in defences.

The flooding in this area has worsened from Flood Zone 2 to 3 since the EA have updated their maps based new modelling outputs.

The 1 in 100 year + 20% climate change undefended fluvial flood model shows flood levels in the north-east corner of 5.01m AOD.

4.3.2 Sequential and Exception Test

Table 13 - Development Compatibility and Flood Assessment Level (as per Section 3.3) for Hepscott Road

Proposed Land Use	Flood Zone	Vulnerability Classification	Vulnerability and Compatibility	Flood Assessment Level
Residential	FZ 1, 2 and 3 (ABD).	More Vulnerable	Sequential Test Required	Detailed
Business/ Employment Space		Less Vulnerable	OK	Intermediate
Community Use		More Vulnerable	Sequential Test Required	Detailed
Public Open Space		Water Compatible Development	OK	Intermediate
Conclusion:	<p>Exception Test is required because residential development is proposed for the site. This can be avoided should the residential land use be located within FZ1.</p> <p>The level of flood assessment may be reduced should the more vulnerable developments be located within FZ1.</p>			

Table 14 - Sequential Test for SA 1.3 Hepscott Road for Residential Land Uses

Stage in Sequential Test	Assessment
Can development be allocated in a lower risk Flood Zone?	<p>Some of the residential development may be directed towards FZ1 within the site, however, this site has the potential to deliver a significant number of residential units to meet the targets of the London Plan within the LLDC area and therefore it may also be located within FZ2 and FZ3. Community uses are required to serve the local area with no other suitable alternative sites.</p> <p>All identified site allocations within the LLDC area whether in FZ 1, 2 or 3 are required in order to meet these London Plan targets.</p>
Conclusion:	<p>As far as practicable, a sequential approach to land allocation should be followed, an Exception Test will need to be carried out due to the presence of FZ3 and the potential residential units and community uses allocated within.</p>

Table 15 – Exception Test for Hepscott Road

NPPF Requirement	Response
It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by an SFRA where one has been prepared.	There is potential for a number of new homes and employment within the site including a focus on encouraging the cultural and creative industries. New walking and cycling routes will also be provided. The site is brownfield land and has previously been marked for redevelopment. A linear park adjacent to the Hertford Union Canal will enhance the surroundings and improve biodiversity of the area.
A site specific Flood Risk Assessment must demonstrate that the development will be safe for its lifetime, taking account of the vulnerability of its users, without increasing flood risk elsewhere and, where possible, will reduce flood risk overall.	A site specific FRA will be required for each development proposal, taking into account the most up to date flood risk information and following the recommendations of the Tower Hamlets SFRA. These recommendations can be seen in Section 3.4.2.
Conclusion:	An appropriate site layout, taking into account a sequential approach to land use allocation and a site specific FRA in compliance with Tower Hamlet's SFRA will ensure the NPPF requirements of the second part of the Exception Test are met.

4.3.3 Updated Breach Assessment

Similarly to SA 1.1 and SA 1.2, the extents of the EA modelled breach assessment do not reach the site. The defences either side of the Hertfordshire Union Canal to the south of the site are sheet piled walls which appear to be in good condition and thus a breach at this location is unlikely. However, the impacts of such a breach should be considered in the FRA.

4.3.4 Climate Change Allowances

Table 16 - Climate Change Allowances as per Section 3.2.1 for Hepscott Road

% increase allowance	Peak Rainfall Intensity	Peak River Flow	
		Flood Zone 2	Flood Zone 3
Residential	20% and 40%	25% and 35%	35% and 70%
Community Uses	20% and 40%	25% and 35%	35% and 70%
Employment/ Business Space	20% and 40%	25%	25% and 35%
Public Open Space	Will be assessed relative to adjacent land	none	25%

4.3.5 Flood Risk Guidance

Residential and community use land uses should, where possible, be steered away from the Flood Zone 3 areas. However, where this is not possible, resilience measures should be put in place which have been outlined in the Tower Hamlets SFRA and can be summarised as follows:

- Undertake Sequential and Exception Tests where necessary in accordance with PPS25
- Pursue opportunities to consider the vulnerability of existing developments and whether there is potential for land swap with lower vulnerability uses.
- Create space for water by locating and designing development appropriately, accommodating for climate change and managing future flood risk
- Consider a combination of defence realignment and floodplain management to reduce the impact of flooding on existing properties
- Promote setting back of development, enabling sustainable flood risk management including upgrading of defences.
- Single storey residential development and basement dwellings should not be considered in areas of high flood risk
- Residual risks such as breaching should be managed through effective emergency planning, site design and protection measures

- The use of open spaces to make space for water during times of flooding should be maximised
- There are to be no basement dwellings within Flood Zone 2 or 3 including the excavation of basements under existing dwellings
- Where development is adjacent to (within 16 metres of) the River Lee Defences, the TE2100 plan recommends that current and future flood risk is reduced through:
 - o Raising existing defences
 - o Demonstrating provision of improved access to existing flood defences
 - o Maintain, enhance or replace flood defences to provide adequate protection for the lifetime of the development
 - o On-site provision of or financial contributions towards the provision of flood risk management infrastructure should be secured to protect the development over its lifetime
- Emergency planning strategies should be put in place for areas deemed at actual risk of flooding.
- Any new or improved canal crossing should fully assess the impact on any upstream flooding.
- Finished floor levels should be set in accordance with EA guidance, assessed on a site by site basis, and should comply with the Latest LLDC Local Plan Flood Risk and Sustainable Drainage Measures Policy.

4.4 SA 1.4 Bream Street

Bream Street is a currently vacant site which is proposed to include mixed use development with employment, residential and creative and cultural uses. There will be an introduction of active canal frontage with access provided along the water front and public open space at the southern end of the site. The footbridge crossing the River Lee Navigation is proposed to be improved.

4.4.1 EA Flood Risk Maps

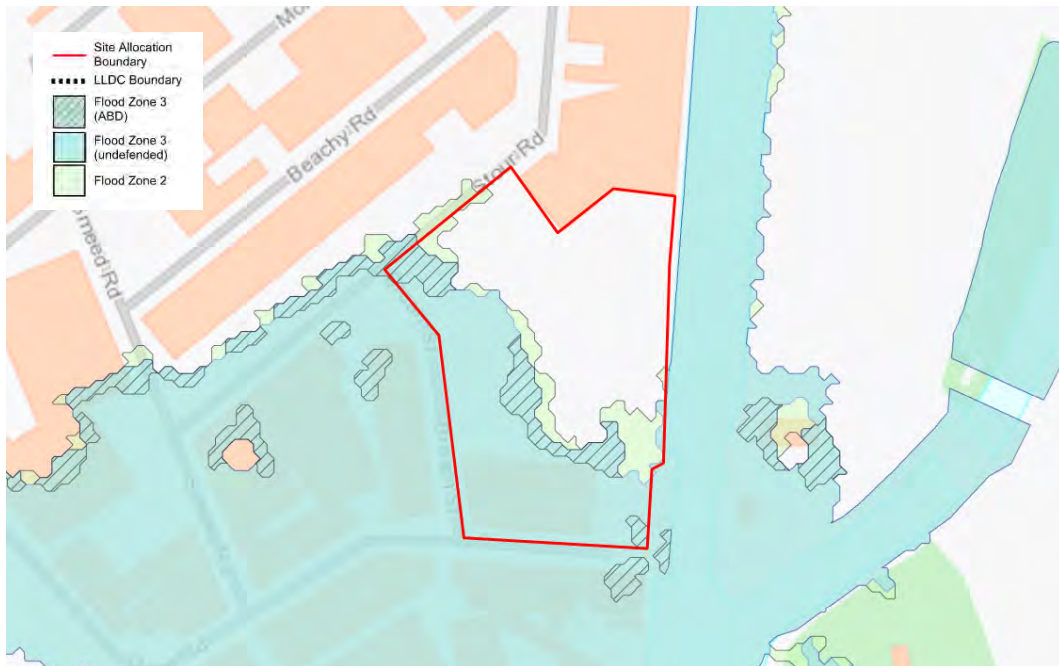


Figure 15 – EA Flood Risk Map for Bream Street

Bream Street lies within Flood Zone 1 to the north, mainly undefended Flood Zone 3 to the south and small areas of Flood Zone 2 and Flood Zone 3 ABDs. Bream Street lies within an area which has been identified by the updated flood modelling as a key flood risk area.

The extent of the Flood Zone 2 areas within the site have reduced since previous modelling and are now Flood Zone 1.

The 1 in 100 year + 20% climate change fluvial flood model shows flood levels are between 5.55m AOD and 5.89m AOD.

4.4.2 Sequential and Exception Tests

Table 17 - Development Compatibility and Flood Assessment Level (as per Section 3.3) for Bream Street

Proposed Land Use	Flood Zone	Vulnerability Classification	Vulnerability and Compatibility	Flood Assessment Level
Residential	Mainly undefended FZ3 to the south, FZ1 north.	More Vulnerable	Sequential Test Required	Detailed
Business/ Employment Space		Less Vulnerable	OK	Intermediate
Public Open Space		Water Compatible Development	OK	Intermediate
Conclusion:	Sequential test is required for residential land uses due to the presence of Flood Zone 2 and 3. Intermediate/detailed flood assessment will only need to be carried out where developments are not within FZ1.			

Table 18 – Sequential Test for Bream Street

Stage in Sequential Test	Assessment
Can development be allocated in a lower risk Flood Zone?	All identified site allocations within the LLDC area whether in FZ 1, 2 or 3 are required in order to meet these London Plan targets. However, more vulnerable development may be able to be steered towards to lower flood risk areas.
Conclusion:	Sequential Test passed, however Exceptions Test is still required due to presence of Flood Zone 3.

4.4.3 Updated Breach Assessment

The flooding extents from the Thames Tidal breach assessment do not reach the site or the vicinity of the site. The site is however, adjacent to the River Lee Navigation and the effect of a breach at a location in this vicinity should be considered.

4.4.4 Climate Change Allowances

Table 19 - Climate Change Allowances as per Section 3.2.1 for Bream Street

% increase allowance	Peak Rainfall Intensity	Peak River Flow	
		Flood Zone 2	Flood Zone 3
Residential	20% and 40%	25% and 35%	35% and 70%
Employment/ Business Space	20% and 40%	25%	25% and 35%
Public Open Space	Will be assessed relative to adjacent land	none	25%

4.4.5 Flood Risk Guidance

Any adjustments made to the River Lee Navigation crossing should be accompanied with a detailed FRA proving that it is not increasing flood risk.

Residential land uses should, where possible, be steered away from the Flood Zone 3 areas. However, where this is not possible, resilience measures should be put in place which have been outlined in the Tower Hamlets SFRA and can be summarised as follows:

- Undertake Sequential and Exception Tests where necessary in accordance with PPS25
- Pursue opportunities to consider the vulnerability of existing developments and whether there is potential for land swap with lower vulnerability uses.
- Create space for water by locating and designing development appropriately, accommodating for climate change and managing future flood risk
- Consider a combination of defence realignment and floodplain management to reduce the impact of flooding on existing properties
- Promote setting back of development, enabling sustainable flood risk management including upgrading of defences.
- Single storey residential development and basement dwellings should not be considered in areas of high flood risk

- Residual risks such as breaching should be managed through effective emergency planning, site design and protection measures
- The use of open spaces to make space for water during times of flooding should be maximised
- There are to be no basement dwellings within Flood Zone 2 or 3 including the excavation of basements under existing dwellings
- Where development is adjacent to (within 16 metres of) the River Lee Defences, the TE2100 plan recommends that current and future flood risk is reduced through:
 - o Raising existing defences
 - o Demonstrating provision of improved access to existing flood defences
 - o Maintain, enhance or replace flood defences to provide adequate protection for the lifetime of the development
 - o On-site provision of or financial contributions towards the provision of flood risk management infrastructure should be secured to protect the development over its lifetime
- Emergency planning strategies should be put in place for areas deemed at actual risk of flooding.
- Any improvements on the footbridge crossing the River should fully assess the impact on upstream flooding.
- Finished floor levels should be set in accordance with EA guidance, assessed on a site by site basis, and should comply with the Latest LLDC Local Plan Flood Risk and Sustainable Drainage Measures Policy.

5 Bromley-by-Bow Flood Risk

5.1 SA 4.1 Bromley-By-Bow

This 8 ha site will be predominantly mixed use including community use, residential, retail comprising a new District Centre, public open space and employment.

5.1.1 EA Flood Risk Maps and Data

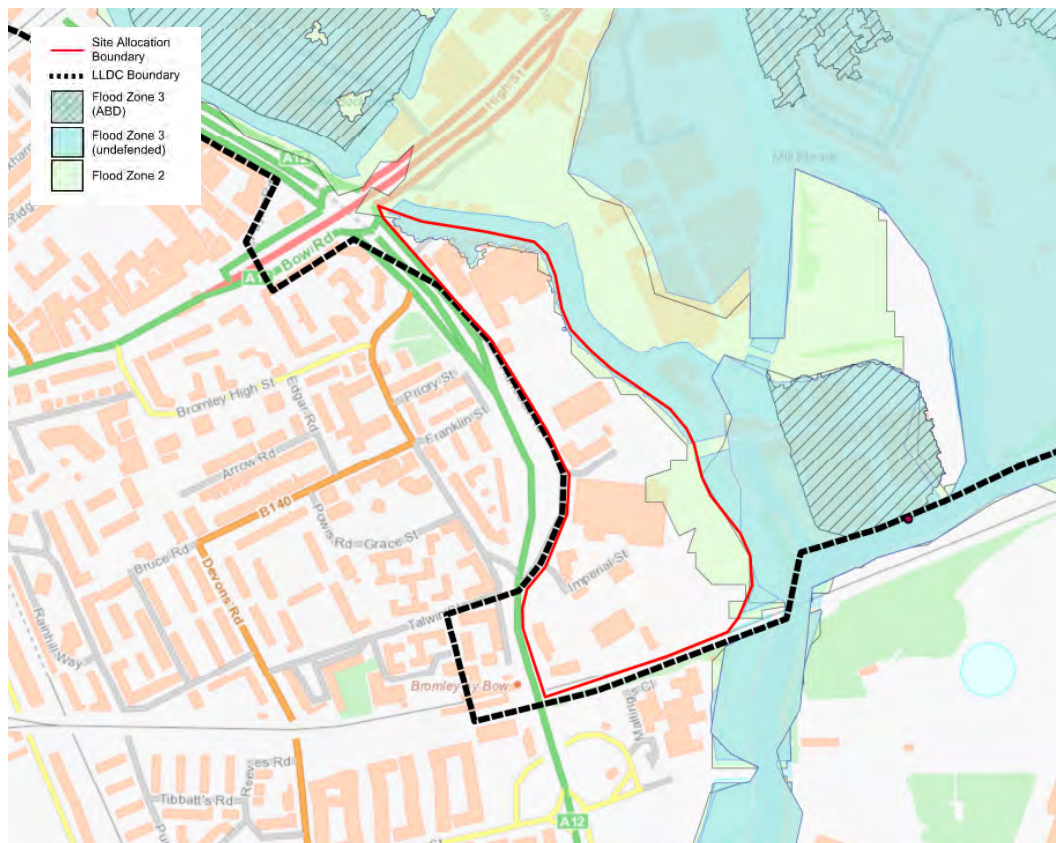


Figure 16 - EA Flood Map for the Bromley by Bow Site Allocation

It can be seen in Figure 16 that the majority of the site lies within FZ1 with small areas of FZ2 and 3 limited to strips adjacent to the river and a slightly larger FZ2 area to the east of the site. The extent of the Flood Zones within the site has reduced since the Flood Maps have been updated according to new modelling outputs.

The nodal data for the 1 in 100 year +20% Climate Change defended fluvial flood within the Bromley-by-Bow area show flood levels are between 4.99m AOD and 5.01mAOD in the northern part of the site where the undefended FZ 3 is shown.

5.1.2 Sequential and Exception Test

Table 20 – Development Compatibility and Flood Assessment Level (as per Section 3.3) for Bromley-by-Bow

Proposed Land Use	Flood Zone	Vulnerability Classification	Vulnerability and Compatibility	Flood Assessment Level
Residential	Primarily FZ1, undefended FZ3 in north adjacent to River, FZ2 in south adjacent to River.	More Vulnerable	Sequential Test Required	Detailed ⁴
Business/ Employment Space		Less Vulnerable	OK	Detailed
Community Use (School and Library)		More Vulnerable	Sequential Test Required	Detailed
Retail		Less Vulnerable	OK	Detailed/ Intermediate
Public Open Space		Water Compatible Development	OK	None
Conclusion:	Sequential Test is required for residential and community land uses due to the presence of Flood Zone 2 and 3.			

Table 21 - Sequential Test for SA 4.1 Bromley-by-Bow Residential and Community Land Uses

Stage in Sequential Test	Assessment
Can development be allocated in a lower risk Flood Zone?	<p>The majority of the site is FZ 1, and areas which are either FZ 2 or 3 are adjacent to the River Lea, and thus would be subject to the 16m buffer zone and therefore development would not be permitted in these areas in many cases. It seems reasonable that the areas of FZ3 in the north can avoid the need for residential land use.</p> <p>All identified site allocations within the LLDC area whether in FZ 1, 2 or 3 are required in order to meet these London Plan targets.</p> <p>The areas of FZ2 are proposed to be a park and part of the new District Centre, residential uses could be avoided for this area.</p> <p>The FZ 3 areas are in the north-eastern end of the site which is proposed to be employment led mixed-use development. Therefore it could be possible to locate residential land uses away from this area.</p>
Conclusion:	Sequential Test passed provided residential land uses avoid FZ3 areas where possible.

⁴ Flood assessment will only need to be carried out if less vulnerable and more vulnerable land uses are located within flood risk zones.

5.1.3 Updated Breach Assessment

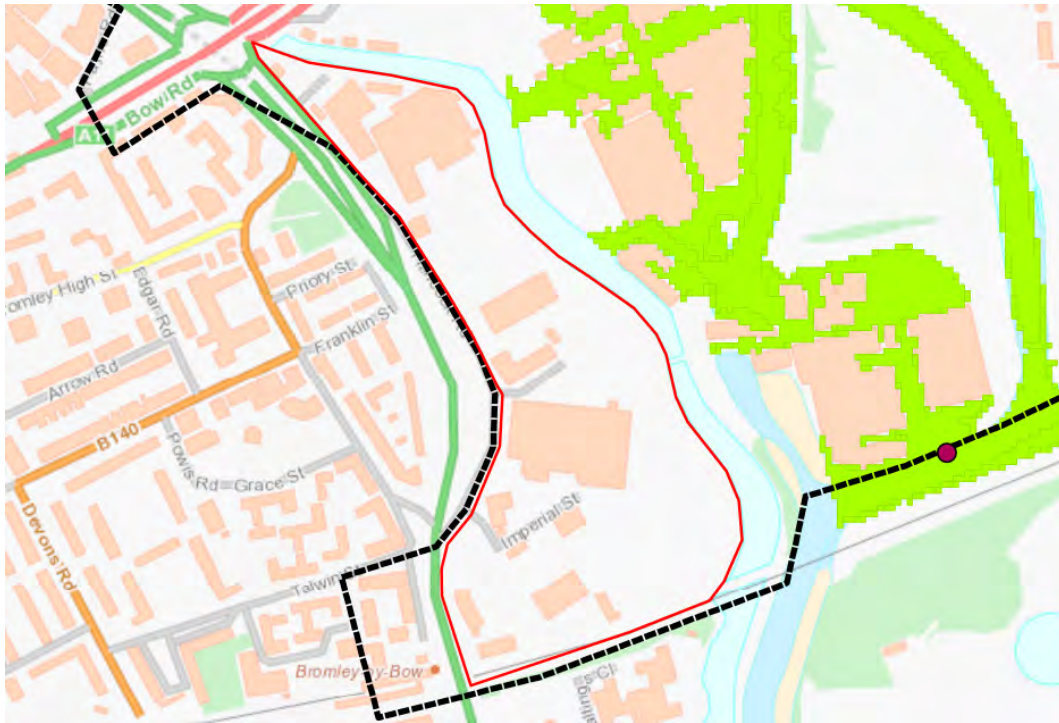


Figure 17 - Thames Tidal Breach Modelling Maximum Extents for MLWL for Bromley by Bow

The Bromley by Bow site is in close proximity to a modelled breach location (shown as red point). The extents of the breach flooding can be seen in green. This does not extend to the site.

5.1.4 Climate Change Allowances

Table 22 - Climate Change Allowances as per Section 3.2.1 for Bromley-by-Bow

% increase allowance	Peak Rainfall Intensity	Peak River Flow	
		Flood Zone 2	Flood Zone 3
Residential	20% and 40%	25% and 35%	35% and 70%
Community Uses	20% and 40%	25% and 35%	35% and 70%
Retail and Leisure	20% and 40%	25%	25% and 35%
Employment/ Business Space	20% and 40%	25%	25% and 35%
Public Open Space	Will be assessed relative to adjacent land	none	25%

5.1.5 Flood Risk Guidance

It is recommended that residential and community use development is located within FZ1 and 2, and that the impact on flood risk of any new or modified bridge structure is thoroughly assessed. A site specific FRA will need to be carried out for each development proposal which will include flood assessment modelling as per Table 20.

For all developments, resilience measures should be put in place which have been outlined in the Tower Hamlets SFRA and can be summarised as follows:

- Undertake Sequential and Exception Tests where necessary in accordance with PPS25
- Pursue opportunities to consider the vulnerability of existing developments and whether there is potential for land swap with lower vulnerability uses.
- Create space for water by locating and designing development appropriately, accommodating for climate change and managing future flood risk
- Consider a combination of defence realignment and floodplain management to reduce the impact of flooding on existing properties
- Promote setting back of development, enabling sustainable flood risk management including upgrading of defences.
- Single storey residential development and basement dwellings should not be considered in areas of high flood risk
- Residual risks such as breaching should be managed through effective emergency planning, site design and protection measures
- The use of open spaces to make space for water during times of flooding should be maximised
- There are to be no basement dwellings within Flood Zone 2 or 3 including the excavation of basements under existing dwellings
- Where development is adjacent to (within 16 metres of) the River Lee Defences, the TE2100 plan recommends that current and future flood risk is reduced through:
 - o Raising existing defences
 - o Demonstrating provision of improved access to existing flood defences
 - o Maintain, enhance or replace flood defences to provide adequate protection for the lifetime of the development
 - o On-site provision of or financial contributions towards the provision of flood risk management infrastructure should be secured to protect the development over its lifetime

- Emergency planning strategies should be put in place for areas deemed at actual risk of flooding.
- Finished floor levels should be set in accordance with EA guidance, assessed on a site by site basis, and should comply with the Latest LLDC Local Plan Flood Risk and Sustainable Drainage Measures Policy.

5.2 Three Mills

Three Mills is not a specific Site Allocation within the LLDC Local Plan, it is however a site which is marked for protecting and enhancing the heritage assets within the area. This could include changes of use, and considering it significantly lies within Flood Zone 3, the impact of any of these changes on flood risk must be fully assessed.

5.2.1 EA Flood Risk Maps and Data

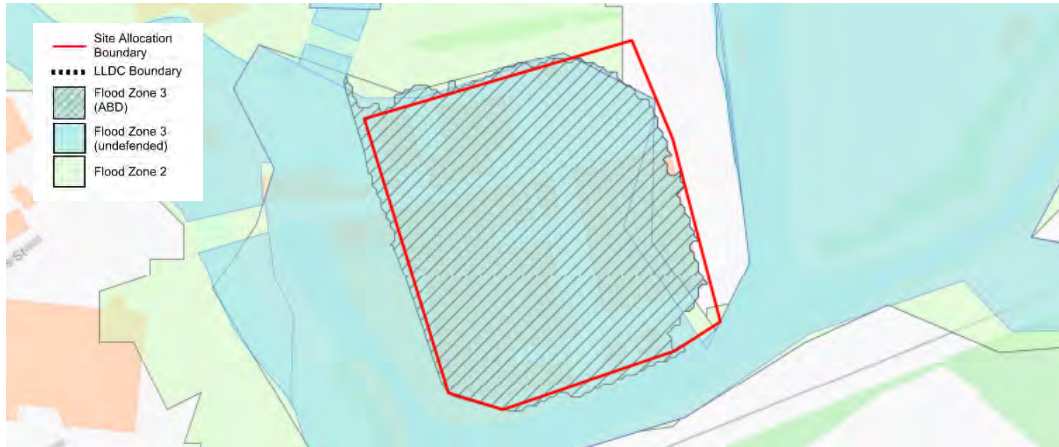


Figure 18 – EA Flood Map for Three Mill Lane

Almost the entire site lies within Flood Zone 3 with the majority benefitting from defences (ABDs) and thus these areas only have a residual risk of flooding. Where the Flood Zone 3 is undefended, there is actual risk of flooding.

The extent of the flooding is the same as the previous maps except the area is now shown to benefit from flood defences.

The 1 in 100 year + 20% climate change fluvial flood model shows no flooding on the site.

5.2.2 Sequential and Exception Test

Table 23 - Development Compatibility and Flood Assessment Level (as per Section 3.3) for Three Mill Lane

Proposed Land Use	Flood Zone	Vulnerability Classification	Vulnerability and Compatibility	Flood Assessment Level
Business/ Employment Space	Flood Zone 3 (mostly ABD), small areas of FZ1 and FZ2.	Less Vulnerable	OK	Detailed
Public Open Space	FZ1 and FZ2.	Water Compatible Development	OK	Intermediate
Conclusion:	Sequential test is required for residential land uses due to the presence of Flood Zone 2 and 3. Detailed flood modelling will need to be undertaken for the whole site given the scale of the proposed development.			

Table 24 – Sequential Test for Three Mill Lane

Stage in Sequential Test	Assessment
Can development be allocated in a lower risk Flood Zone?	There are no other sites which are able to allocate the number of units required in order to meet the housing targets for the LLDC area in the London Plan. All identified site allocations within the LLDC area whether in FZ 1, 2 or 3 are required in order to meet these London Plan targets.
Conclusion:	Sequential Test passed but Exceptions Test still required due to presence of FZ3.

Table 25 – Exceptions Test for Three Mill Lane

NPPF Requirement	Response
It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by an SFRA where one has been prepared.	This redevelopment will regenerate the cultural heritage of the area and promote creative and cultural industries
A site specific Flood Risk Assessment must demonstrate that the development will be safe for its lifetime, taking account of the vulnerability of its users, without increasing flood risk elsewhere and, where possible, will reduce flood risk overall.	A site specific FRA will be required for each development proposal, taking into account the most up to date flood risk information and following the recommendations of the Newham SFRA. These recommendations can be seen in Section 3.4.4.
Conclusion:	An appropriate site layout, land use allocation and a site Specific FRA in compliance with Newham's SFRA will ensure the NPPF requirements of the second part of the Exception Test are met.

5.2.3 Updated Breach Assessment

The breach assessment shows that the site would be inundated in the event of a breach. The extents of this can be seen in Figure 19. The site surrounded by watercourses and thus is surrounded by defences and is vulnerable should a breach occur at any one of them, and the likelihood of a breach occurring is therefore higher.

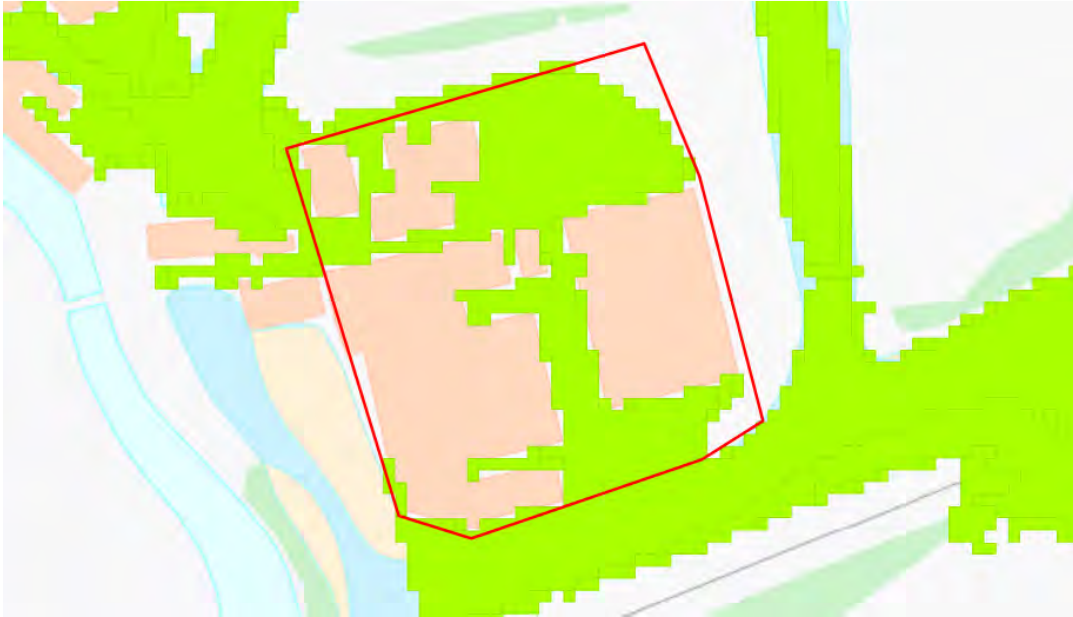


Figure 19 - Thames Tidal Breach Modelling Maximum Extents for MLWL for Three Mill Lane.

5.2.4 Climate Change Allowances

Table 26 - Climate Change Allowances as per Section 3.2.1 for Three Mill Lane

% increase allowance	Peak Rainfall Intensity	Peak River Flow	
		Flood Zone 2	Flood Zone 3
Employment/ Business Space	20% and 40%	25%	25% and 35%
Public Open Space	Will be assessed relative to adjacent land	none	25%

5.2.5 Flood Risk Guidance

For all types of land use apart from water compatible development, a detailed flood assessment will need to be carried out which will include either re-running existing models (if they are available) or creating new models and take into account the new requirements for climate change as described in Section 3.2.1 and 3.3.

Where possible, residential and community land use should be avoided on this site due to the entire site being located within Flood Zone 3. However, where this isn't possible, the flood resilience measures outlined in the LB Newham SFRA should be followed:

- 8-16 metre wide undeveloped buffer strip alongside river corridors should be considered
- Presumption against further culverting

- Maximise opportunities to deculvert/ undertake river restoration.
- Ensure Sequential Test has been undertaken where necessary
- Development does not increase flood risk by providing level for level floodplain compensation
- Site is designed sequentially by avoiding placing buildings within the natural floodplain
- Opportunities to locate water compatible development to Flood Zone 2 and 3 and move vulnerable development to Flood Zone 1 should be maximised.
- Where development is adjacent to (within 16 metres of) the River Lee Defences, the TE2100 plan recommends that current and future flood risk is reduced through:
 - o Raising existing defences;
 - o Demonstrating provision of improved access to existing flood defences;
 - o Maintain, enhance or replace flood defences to provide adequate protection for the lifetime of the development; and
 - o On-site provision of or financial contributions towards the provision of flood risk management infrastructure should be secured to protect the development over its lifetime
- The Council should seek measures to reduce flood risk by considering:
 - o Making lengths of the flood defence ‘unbreachable’
 - o Introduce secondary defences through a strategic approach;
 - o Site specific secondary defences;
 - o Use lower vulnerability land uses around perimeter of a development to act as a secondary flood defences to higher vulnerability development within the centre.
- Finished floor levels should be set in accordance with EA guidance, assessed on a site by site basis, and should comply with the Latest LLDC Local Plan Flood Risk and Sustainable Drainage Measures Policy.

6 Pudding Mill and Stratford Flood Risk

6.1 SA 3.4 Greater Carpenters District

This is an existing mixed use area which is proposed to be redeveloped and include residential, further business areas, commercial and community and education land uses. The redevelopment of this site is also referred to in the Stratford Metropolitan Masterplan.

6.1.1 EA Flood Risk Maps and Data



Figure 20 – EA Flood Map for Greater Carpenters District

The majority of the site lies within Flood Zone 3, all of which is defended. The remainder of the site is Flood Zone 1 with small areas of Flood Zone 2 in the northern and southern corners.

The flooding is less severe since the Flood Maps have been updated, the areas of Flood Zone 1 are now more extensive around the perimeter of the site.

The 1 in 100 year + 20% climate change fluvial flood model shows no flooding on the site.

6.1.2 Sequential and Exception Test

Table 27 - Development Compatibility and Flood Assessment Level (as per Section 3.3)

Proposed Land Use	Flood Zone	Vulnerability Classification	Vulnerability and Compatibility	Flood Assessment Level
Business/ Employment Space	Flood Zone 3 (ABDs), small areas of FZ1 and FZ2.	Less Vulnerable	OK	Detailed
Residential		More Vulnerable	Sequential Test Required	Detailed
Public Open Space		Water Compatible Development	OK	Intermediate
Conclusion:	Sequential test is required for residential land uses due to the presence of Flood Zone 2 and 3. Detailed flood modelling will need to be undertaken for the whole site given the scale of the proposed development.			

Table 28 – Sequential Test for Greater Carpenters District

Stage in Sequential Test	Assessment
Can development be allocated in a lower risk Flood Zone?	There are no other sites which are suitable to allocate the number of units required in order to meet the housing targets for the LLDC area in the London Plan. All identified site allocations within the LLDC area whether in FZ 1, 2 or 3 are required in order to meet these London Plan targets. The areas of FZ2 are proposed to be a park and part of the new District Centre, residential uses can be avoided for this area. The FZ 3 areas are in the north-eastern end of the site which is proposed to be employment led mixed-use development. Therefore it could be possible to locate residential land uses away from this area.
Conclusion:	Sequential Test passed provided residential land uses avoid FZ3 as far as is practical.

Table 29 – Exceptions Test for Greater Carpenters District

NPPF Requirement	Response
It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by an SFRA where one has been prepared.	This site was not specifically considered in the Newham SFRA, but there is potential for a number of new homes and extensive mixed use redevelopment within the site with an increase in the amount of business, commercial, education and community uses.
A site specific Flood Risk Assessment must demonstrate that the development will be safe for its lifetime, taking account of the vulnerability of its users, without increasing flood risk elsewhere and, where possible, will reduce flood risk overall.	A site specific FRA will be required for each new development or redevelopment proposal, taking into account the most up to date flood risk information and following the recommendations of the Newham SFRA and ensure that sustainable urban drainage systems are incorporated into the design responses. These recommendations can be seen in Section 3.4.4.
Conclusion:	An appropriate site layout and a site Specific FRA in compliance with Newham's SFRA will ensure the NPPF requirements of the second part of the Exception Test is met.

6.1.3 Updated Breach Assessment

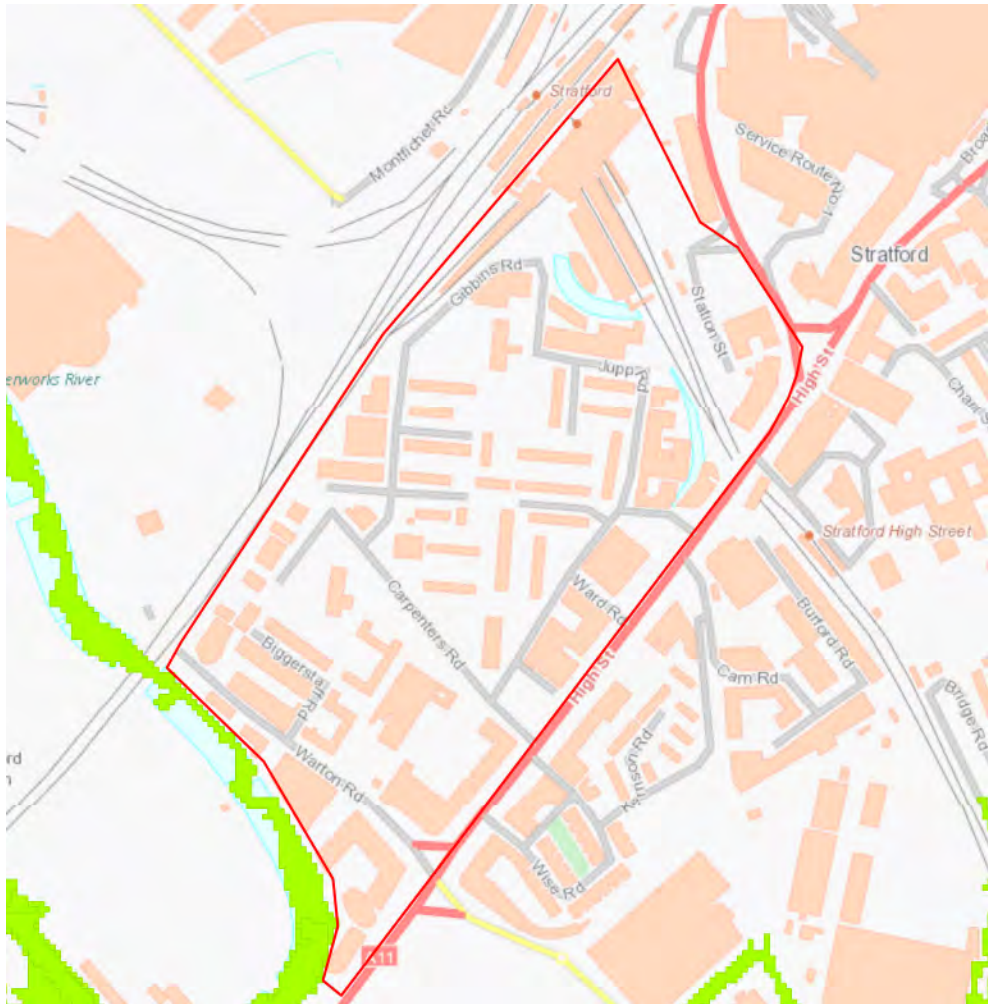


Figure 21 - Thames Tidal Breach Modelling Maximum Extents for MLWL for Great Carpenters District

The flood extents from the breach modelling do not reach past the site boundary and thus the site is unaffected according to this modelling. This is insufficient evidence to conclude that a breach of flood defences would not affect the site due to the distance of the site from the modelled breach location. It is suggested that a breach assessment is carried out for a location adjacent to the site.

6.1.4 Climate Change Allowances

Table 30 - Climate Change Allowances as per Section 3.2.1

% increase allowance	Peak Rainfall Intensity	Peak River Flow	
		Flood Zone 2	Flood Zone 3
Residential	20% and 40%	25% and 35%	35% and 70%
Community Uses	20% and 40%	25% and 35%	35% and 70%
Retail and Leisure	20% and 40%	25%	25% and 35%
Employment/ Business Space	20% and 40%	25%	25% and 35%
Public Open Space	Will be assessed relative to adjacent land	none	25%

6.1.5 Flood Risk Guidance

As far as possible, land uses should be allocated sequentially, that is, more vulnerable land uses within Flood Zones 1 and 2, and less vulnerable land uses towards Flood Zone 3, although it is understood the existing layout will more or less be retained, and therefore this may be difficult. The flood resilience measures outlined in the LB Newham SFRA should be followed:

- 8-16 metre wide undeveloped buffer strip alongside river corridors;
- Where development is adjacent to (within 16 metres of) the River Lee Defences, the TE2100 plan recommends that current and future flood risk is reduced through:
 - o Raising existing defences;
 - o Demonstrating provision of improved access to existing flood defences;
 - o Maintain, enhance or replace flood defences to provide adequate protection for the lifetime of the development; and
 - o On-site provision of or financial contributions towards the provision of flood risk management infrastructure should be secured to protect the development over its lifetime
- Presumption against further culverting;
- Maximise opportunities to deculvert/ undertake river restoration;
- Ensure Sequential Test has been undertaken where necessary;
- Development does not increase flood risk by providing level for level floodplain compensation;

- Site is designed sequentially by avoiding placing buildings within the natural floodplain;
- Opportunities to locate water compatible development to Flood Zone 2 and 3 and move vulnerable development to Flood Zone 1 should be maximised; and
- The Council should seek measures to reduce flood risk by considering:
 - o Making lengths of the flood defence ‘unbreachable’
 - o Introduce secondary defences through a strategic approach
 - o Site specific secondary defences
 - o Use lower vulnerability land uses around perimeter of a development to act as a secondary flood defences to higher vulnerability development within the centre.
- Finished floor levels should be set in accordance with EA guidance, assessed on a site by site basis, and should comply with the Latest LLDC Local Plan Flood Risk and Sustainable Drainage Measures Policy.
 - o

6.2 SA 3.6 Rick Roberts Way

The site is currently vacant land and is proposed to be a mixed use development with residential, education and open space provisions. There is current planning permission for 400 residential units, 550 sq m retail and 11,600 sq m for a school.

6.2.1 EA Flood Risk Maps and Data

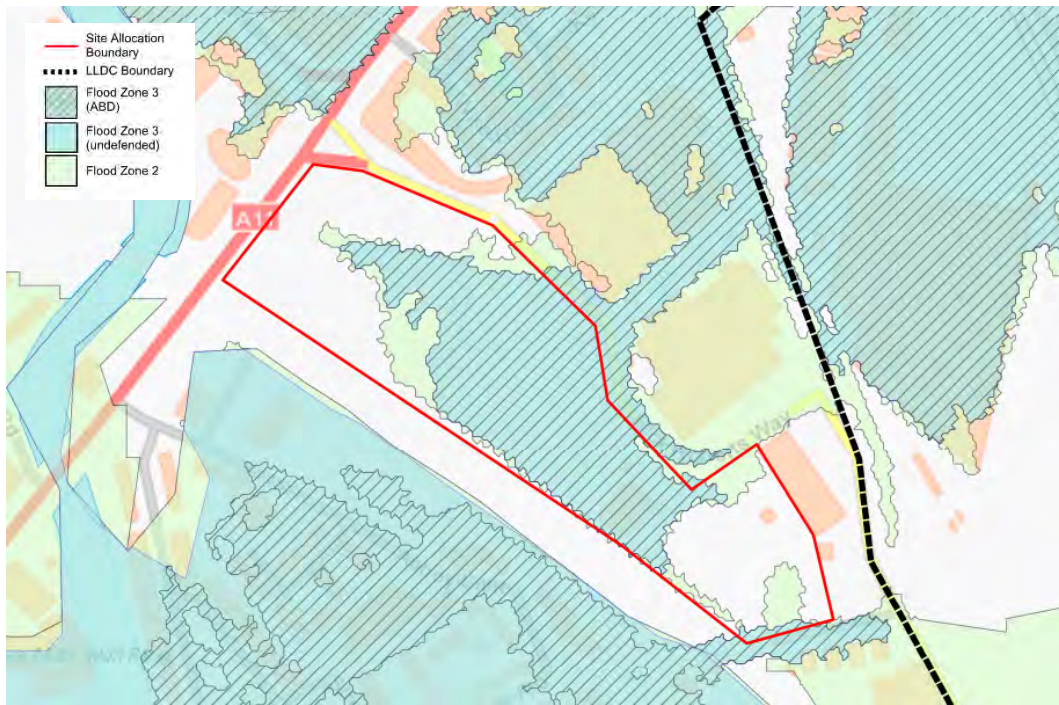


Figure 22 – EA Flood Map for Rick Roberts Way

The majority of the site lies within Flood Zone 3, all of which benefit from flood defences, and thus there is only a residual risk of flooding. The rest of the site, mainly to the north-west is Flood Zone 1, with a small area of Flood Zone 2 as shown in Figure 22.

The extents of the flood risk areas have reduced since the Flood Maps have been updated, especially in the south where the area of Flood Zone 2 has greatly reduced.

The 1 in 100 year + 20% climate change fluvial flood model shows no flooding on the site.

6.2.2 Sequential and Exception Test

Table 31 - Development Compatibility and Flood Assessment Level (as per Section 3.3) for Rick Roberts Way

Proposed Land Use	Flood Zone	Vulnerability Classification	Vulnerability and Compatibility	Flood Assessment Level
Business/ Employment Space	FZ3 (ABD – central area) FZ1 (north and south) and small areas of FZ2.	Less Vulnerable	OK	Detailed
Residential		More Vulnerable	Sequential Test Required	Detailed
Community (School)		More Vulnerable	Sequential Test Required	Intermediate
Public Open Space		Water Compatible Development	OK	Intermediate
Conclusion:	Sequential test is required for residential and community land uses due to the presence of Flood Zone 2 and 3. Detailed flood modelling will need to be undertaken for more vulnerable land uses within these areas.			

Table 32 – Sequential Test for Rick Roberts Way

Stage in Sequential Test	Assessment
Can development be allocated in a lower risk Flood Zone?	There are no other sites which are suitable to allocate the number of residential units required in order to meet the housing targets for the LLDC area in the London Plan. There are no other sites which are of the right scale or location in which to locate a school. All identified site allocations within the LLDC area whether in FZ 1, 2 or 3 are required in order to meet these London Plan targets.
Conclusion:	Although more vulnerable land uses will be located within Flood Zone 3, a site specific FRA has been undertaken and the proposals are deemed acceptable. An Exception Test is still required for areas outside of those with extant planning permission.

Table 33 – Exception Test for Rick Roberts Way

NPPF Requirement	Response
It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by an SFRA where one has been prepared.	This site was not specifically considered in the Newham SFRA, but there is potential for a number of new homes within the site and fulfil the Local Plan requirement for a new secondary or all-through school. The provision of business space will also provide employment within the area.
A site specific Flood Risk Assessment must demonstrate that the development will be safe for its lifetime, taking account of the vulnerability of its users, without increasing flood risk elsewhere and, where possible, will reduce flood risk overall.	A site specific FRA will be required for each new development proposal, taking into account the most up to date flood risk information and following the recommendations of the Newham SFRA. These recommendations can be seen in Section 3.4.4. A site specific FRA has already been undertaken for the central and northern parts of the site which are proposed to include residential units and a school. This has concluded that the land uses are acceptable and planning permission has been granted.
Conclusion:	An appropriate site layout and a site Specific FRA in compliance with Newham’s SFRA will ensure the NPPF requirements of the second part of the Exception Test are met.

6.2.3 Updated Breach Assessment

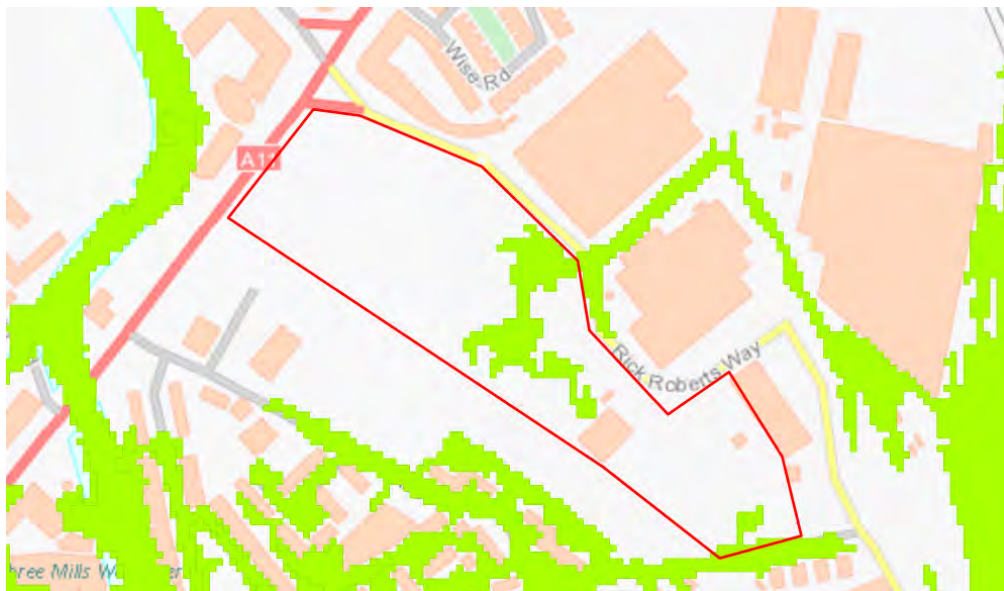


Figure 23 - Thames Tidal Breach Modelling Maximum Extents for MLWL for Stratford Waterfront East

The flood extents from the breach modelling reach within the site boundaries and thus the site is at risk should a breach of the Thames Tidal Defences occur.

6.2.4 Climate Change Allowances

Table 34 - Climate Change Allowances as per Section 3.2.1 for Rick Roberts Way

% increase allowance	Peak Rainfall Intensity	Peak River Flow	
		Flood Zone 2	Flood Zone 3
Residential	20% and 40%	25% and 35%	35% and 70%
Community Uses	20% and 40%	25% and 35%	35% and 70%
Employment/ Business Space	20% and 40%	25%	25% and 35%
Public Open Space	Will be assessed relative to adjacent land	none	25%

6.2.5 Flood Risk Guidance

A sequential approach to land use allocated should be followed by locating the most vulnerable land uses within low flood risk areas, this includes the school and residential units. It can be seen from the LLDC Local Plan that the school is proposed to be in the central area of the development, this has been subject to a site specific Flood Risk Assessment which concluded that the proposed use was acceptable. The central and northern parts of the site currently have planning permission for residential and community uses. The southern part of the site does not however, and therefore must pass the Exception Test.

Any areas within the site without extant planning permission and within Flood Zone 3 must undergo detailed or at least intermediate flood assessment as described in Section 3.3.

The flood resilience measures outlined in the LB Newham SFRA should be followed:

- 8-16 metre wide undeveloped buffer strip alongside river corridors
- Presumption against further culverting
- Maximise opportunities to deculvert/ undertake river restoration.
- Ensure Sequential Test has been undertaken where necessary
- Development does not increase flood risk by providing level for level floodplain compensation
- Site is designed sequentially by avoiding placing buildings within the natural floodplain
- Opportunities to locate water compatible development to Flood Zone 2 and 3 and move vulnerable development to Flood Zone 1 should be maximised.
- The Council should seek measures to reduce flood risk by considering:

- Making lengths of the flood defence ‘unbreachable’
 - Introduce secondary defences through a strategic approach
 - Site specific secondary defences
 - Use lower vulnerability land uses around perimeter of a development to act as a secondary flood defences to higher vulnerability development within the centre.
- Finished floor levels should be set in accordance with EA guidance, assessed on a site by site basis, and should comply with the Latest LLDC Local Plan Flood Risk and Sustainable Drainage Measures Policy.

6.3 SA 4.3 Pudding Mill

This site allocation will be a medium density mixed use area including business floor space, a new Local Centre, new residential units focussed on family housing, public realm and public open space.

6.3.1 EA Flood Risk Maps and Data

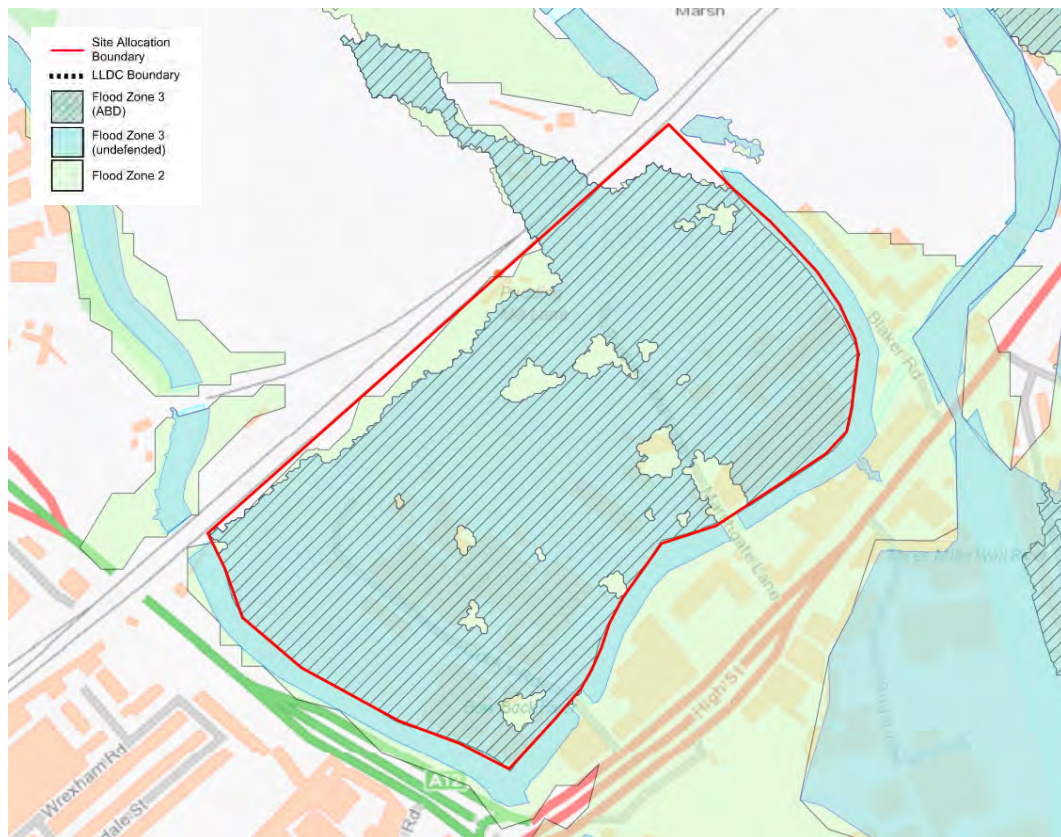


Figure 24 – EA Flood Map for Pudding Mill

The majority of the Pudding Mill site lies within Flood Zone 3 (ABDs) with small areas of Flood Zone 1 and 2. Because the Flood Zone 3 benefits from flood defence, there is only a residual risk of flooding.

The extent of Flood Zone 3 has slightly reduced since the Flood Maps have been updated.

The 1 in 100 year + 20% climate change fluvial flood model shows no flooding on the site.

6.3.2 Sequential and Exception Test

Table 35 - Development Compatibility and Flood Assessment Level (as per Section 3.3) for Pudding Mill

Proposed Land Use	Flood Zone	Vulnerability Classification	Vulnerability and Compatibility	Flood Assessment Level
Business/ Employment Space	Flood Zone 3 (ABDs), small areas of FZ1 and FZ2.	Less Vulnerable	OK	Detailed
Residential		More Vulnerable	Sequential Test Required	Detailed
Retail		Less Vulnerable	OK	Detailed
Community (School)		More Vulnerable	Sequential Test Required	Detailed
Public Open Space		Water Compatible Development	OK	Intermediate
Conclusion:		Sequential test is required for residential land uses due to the presence of Flood Zone 2 and 3. Detailed flood modelling will need to be undertaken for the whole site given the scale of the proposed development.		

Table 36 – Sequential Test for Pudding Mill

Stage in Sequential Test	Assessment
Can development be allocated in a lower risk Flood Zone?	<p>There are no other sites which are suitable to allocate the number of units required in order to meet the housing targets for the LLDC area in the London Plan. Almost all locations within Flood Zone 1 or 2 are already developed or are allocated for open space. The community land uses are required in order to serve the local residential and business community.</p> <p>There are small areas of Flood Zone 1 and 2 and it would not be practical to tailor the masterplan layout to move land uses to these specific areas.</p> <p>All identified site allocations within the LLDC area whether in FZ 1, 2 or 3 are required in order to meet these London Plan targets.</p>
Conclusion:	Although more vulnerable land uses will be located within Flood Zone 3, a site specific FRA has been undertaken and the proposals are deemed acceptable. An exception Test is still required for areas outside of those with extant planning permission.

Table 37 – Exceptions Test for Pudding Mill

NPPF Requirement	Response
It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by an SFRA where one has been prepared.	The regeneration of this brownfield site will bring wider sustainability benefits to the community which outweigh the flood risk. Developing this site is essential in achieve the spatial strategy and regeneration aspirations outlined in the London Plan.
A site specific Flood Risk Assessment must demonstrate that the development will be safe for its lifetime, taking account of the vulnerability of its users, without increasing flood risk elsewhere and, where possible, will reduce flood risk overall.	A site specific FRA will be required for each new development proposal, taking into account the most up to date flood risk information, following the recommendations of the Newham SFRA and incorporate sustainable urban drainage systems. These recommendations can be seen in Section 3.4.4.
Conclusion:	An appropriate site design and a site Specific FRA in compliance with Newham’s SFRA will ensure the NPPF requirements of the second part of the Exception Test are met.

6.3.3 Updated Breach Assessment



Figure 25 - Thames Tidal Breach Modelling Maximum Extents for MLWL for Pudding Mill

It can be seen from Figure 25 that the extent of flooding shown by the Thames Tidal breach assessment modelling reaches within the site boundaries and therefore the site is at risk of flooding should a breach occur at the modelled location.

6.3.4 Climate Change Allowances

Table 38 – Climate Change Allowances as per Section 3.2.1 for Pudding Mill

% increase allowance	Peak Rainfall Intensity	Peak River Flow	
		Flood Zone 2	Flood Zone 3
Residential	20% and 40%	25% and 35%	35% and 70%
Community Uses	20% and 40%	25% and 35%	35% and 70%
Retail and Leisure	20% and 40%	25%	25% and 35%
Employment/ Business Space	20% and 40%	25%	25% and 35%
Public Open Space	Will be assessed relative to adjacent land	none	25%

6.3.5 Flood Risk Guidance

A site specific FRA will need to be carried out for each development proposal and in most cases, a detailed level of flood assessment will need to be carried out as outlined in Section 3.3.

Given that Pudding Mill predominantly lies within Flood Zone 3, a sequential approach to land use allocation within the site is not possible. However, the following resilience measures should be adhered to for the design proposals:

- 8-16 metre wide undeveloped buffer strip alongside river corridors
- Where development is adjacent to (within 16 metres of) the River Lee Defences, the TE2100 plan recommends that current and future flood risk is reduced through:
 - o Raising existing defences;
 - o Demonstrating provision of improved access to existing flood defences;
 - o Maintain, enhance or replace flood defences to provide adequate protection for the lifetime of the development; and
 - o On-site provision of or financial contributions towards the provision of flood risk management infrastructure should be secured to protect the development over its lifetime
- Presumption against further culverting
- Maximise opportunities to deculvert/ undertake river restoration.
- Ensure Sequential Test has been undertaken where necessary
- Development does not increase flood risk by providing level for level floodplain compensation
- Site is designed sequentially by avoiding placing buildings within the natural floodplain
- Opportunities to locate water compatible development to Flood Zone 2 and 3 and move vulnerable development to Flood Zone 1 should be maximised.
- The Council should seek measures to reduce flood risk by considering:
 - o Making lengths of the flood defence ‘unbreachable’
 - o Introduce secondary defences through a strategic approach
 - o Site specific secondary defences
 - o Use lower vulnerability land uses around perimeter of a development to act as a secondary flood defences to higher vulnerability development within the centre.

- Finished floor levels should be set in accordance with EA guidance, assessed on a site by site basis, and should comply with the Latest LLDC Local Plan Flood Risk and Sustainable Drainage Measures Policy.

7 Conclusions

The principal changes to the way flood risk assessment of the site allocations within the LLDC area should now be carried out are:

- There are newly modelled Areas Benefitting from Defence which allows it to be determined whether there is an actual or residual risk of flooding for a particular site
- The River Lee has had updated flood mapping and therefore the extents of flood risk areas have changed since flood risk assessments were last carried out
- The method of calculating allowance for climate change has been updated and the allowances varies depending on the size of the development, the design life, the location, the land use type and the parameter that climate change is being applied to.
- The level of detail of assessment which needs to be undertaken when modelling climate change also varies depending on the size of development, the flood zone and the vulnerability classification.
- A detailed assessment will require ‘detailed’ hydraulic modelling to be undertaken by either re-running EA hydraulic models (if available) or construction of a new model by the developer
- In a number of cases, two separate climate change allowances will need to be modelled and the results compared to determine the impact the allowances have.