Main mechanism of flooding	Main characteristic of flooding	Adverse consequences to human health	Human health consequences - residential properties	Property count method	Other human health consequences	Adverse economic consequences	Number of non-residential properties flooded	Property count method	Other economic consequences	Adverse consequences to the environment	Environment consequences	Adverse consequences to cultural heritage	Cultural heritage consequences
Mandatory	**Mandatory**	**Mandatory**	Optional	Optional	Optional	**Mandatory**	Optional	Optional	Optional	**Mandatory**	Optional	**Mandatory**	Optional
Pick from drop-down	Pick from drop-down	Pick from drop-down	Number between 1-10,000,000	Pick from drop-down	Max 250 characters	Pick from drop-down	Number between 1-10,000,000	Pick from drop-down	Max 250 characters	Pick from drop-down	Max 250 characters	Pick from drop-down	Max 250 characters
Pick a mechanism from; 'Natural exceedance' (of capacity), 'Defence exceedance' (floodwater overtopping defences), 'Failure' (of natural or artificial defences or infrastructure, or of pumping), 'Blockage or restriction' (natural or artificial blockage or restriction of a conveyance channel or system), or 'No data'.	Pick a characteristic from; 'Flash flood' (rises and falls quite rapidly with little or no advance warning), 'Natural flood' (due to significant precipitation, at a slower rate than a flash flood), 'Snow melt flood' (due to rapid snow melt), 'Debris flow' (conveying a high degree of debris), or 'No data'. Most UK floods are 'Natural floods'.	Would there be any significant consequences to human health if the future flood were to occur?	Record the number of residential properties where the building structure would be affected either internally or externally if the flood were to occur.	Where residential or non-residential properties have been counted, it is important to record the method of counting, to aid comparisons between counts. Choose from; 'Detailed GIS' (using property outlines, as per Environment Agency guidance), 'Simple GIS' (using property points), 'Estimate from map', or 'Observed number'.	If there would be other Significant consequences to human health, describe them including information such as the number of critical services flooded.	Would there be any significant economic consequences if the future flood were to occur?	Record the number of non-residential properties where the building structure would be affected either internally or externally if the flood were to occur.	Where residential or non-residential properties have been counted, it is important to record the method of counting, to aid comparisons between counts. Choose from; 'Detailed GIS' (using property outlines, as per Environment Agency guidance), 'Simple GIS' (using property points), 'Estimate from map', or 'Observed number'.	If there would be other Significant economic consequences, describe them including information such as the area of agricultural land flooded, length of roads and rail flooded.	Would there be any significant consequences to the environment if the future flood were to occur?	If there would be Significant consequences to the environment, describe them including information such as national and international designated sites flooded, and pollution sources flooded.	Would there be any significant consequences to cultural heritage if the future flood were to occur?	If there would be Significant consequences to cultural heritage, describe them including information such as the number and type of heritage assets flooded.
Natural exceedance	Natural flood	Yes	12000	Detailed GIS		No				No		No	
Natural exceedance	Natural flood	Yes	31600	Detailed GIS		Yes	3900	Detailed GIS		Yes			
Natural exceedance	Natural flood	Yes	12600	Detailed GIS		Yes	1600	Detailed GIS		Yes			
Natural exceedance	Natural flood	Yes				Yes				Yes			

Comments	Data owner	Area flooded	Confidence in modelled outline	Model date	Model Type	Hydrology Type	Lineage	Sensitive data	Protective marking descriptor	European Flood Event Code
Optional Max 1,000 characters Any additional comments about the future flood record.	Optional Max 250 characters	Optional Number with two decimal places The total area of the land flooded, in km^2	Optional Pick from drop-down Pick a broad level of confidence in the modelled flood outline from; 'High' (good match to past flood extents - about 80% confident that outline is correct), 'Medium' (reasonable match - about 50% confident that outline is correct), 'Low' (poor match, sparse data - about 20% confident that outline is correct) or 'Unknown'.	Optional 'yyyy' or 'yyyy-mm' or 'yyyy-mm-dd'	Optional Max 250 characters Type of software used to create future flood information.	Optional Max 250 characters Type of hydrology method used to create future flood information.	Optional Max 250 characters Lineage is how and what the data is made from. Has this data been created by using data owned or derived from data owned by 3rd party (external) organisations? If yes please give details.	Optional Pick from drop-down Has the information been classified under the Government's Protective Marking Scheme? Include protective marking time limit where known. Note: If "Approved for Access" then report "Unmarked".	Optional Max 50 characters For use where organisations apply the Government's Protective Marking Scheme.	Auto-populated Max 42 characters This field will autopopulate using the LLFA name provided on the "Instructions" tab, and the Flood ID. It is an EU-wide unique identifier and will be used to report the flood information. Format: UK<ONS Code><P or F><LLFA Flood ID>. "ONS Code" is a unique reference for each LLFA. "P or F" indicates if the event is past or future. "LLFA Flood ID" is a sequential number beginning with 0001.
	Epping Forest District Council		Medium-Low	2008-08	2D-TuFlow	FEH (Revised Rainfall Runoff)	Ordnance Survey AddressPoint; CEH 1:50k River Centreline; NextMap DTM.	Unmarked	Private	UKE10000012F0001
	JBA Consulting (distributed by Environment Agency under licence)		Low	2009-07	JFLOW-GPU	Depth-duration-frequency curves derived from FEH CD-ROM, from centre of each 5km model, with areal reduction factor applied to convert point rainfall estimate to more representative figure. Curve then used to derive 6.5 hr, 1:200 chance rainfall depth; this is converted to hyetograph, using summer rainfall profile.		Protect	Commercial	UKE09000027F0001
	JBA Consulting (distributed by Environment Agency under licence)		Low	2009-07	JFLOW-GPU	Depth-duration-frequency curves derived from FEH CD-ROM, from centre of each 5km model, with areal reduction factor applied to convert point rainfall estimate to more representative figure. Curve then used to derive 6.5 hr, 1:200 chance rainfall depth; this is converted to hyetograph, using summer rainfall profile.		Protect	Commercial	UKE09000027F0002
	JBA Consulting (distributed by Environment Agency under licence)		Low	2009-07	JFLOW-GPU	Depth-duration-frequency curves derived from FEH CD-ROM, from centre of each 5km model, with areal reduction factor applied to convert point rainfall estimate to more representative figure. Curve then used to derive 6.5 hr, 1:200 chance rainfall depth; this is converted to hyetograph, using summer rainfall profile.		Protect	Commercial	UKE09000027F0003

	Environment Agency	Medium-Low	2010-11	JFLOW-GPU	Depth-duration-frequency curves derived from FEH CD-ROM, from centre of each 5km model, with areal reduction factor applied to convert point rainfall estimate to more representative figure. Curve then used to derive 1.1 hr, 1:30 chance rainfall depth; this is converted to hyetograph, using summer rainfall profile. See "Description of assessment method" for allowances for infiltration and drainage.	Rainfall Hyetograph, EA 2m Composite DTM, OSMM Topography	Unmarked		UKE09000027F0004
	Environment Agency	Medium-Low	2010-11	JFLOW-GPU	Depth-duration-frequency curves derived from FEH CD-ROM, from centre of each 5km model, with areal reduction factor applied to convert point rainfall estimate to more representative figure. Curve then used to derive 1.1 hr, 1:30 chance rainfall depth; this is converted to hyetograph, using summer rainfall profile. See "Description of assessment method" for allowances for infiltration and drainage.	Rainfall Hyetograph, EA 2m Composite DTM, OSMM Topography	Unmarked		UKE09000027F0005
	Environment Agency	Medium-Low	2010-11	JFLOW-GPU	Depth-duration-frequency curves derived from FEH CD-ROM, from centre of each 5km model, with areal reduction factor applied to convert point rainfall estimate to more representative figure. Curve then used to derive 1.1 hr, 1:200 chance rainfall depth; this is converted to hyetograph, using summer rainfall profile. See "Description of assessment method" for allowances for infiltration and drainage.	Rainfall Hyetograph, EA 2m Composite DTM, OSMM Topography	Unmarked		UKE09000027F0006
	Environment Agency	Medium-Low	2010-11	JFLOW-GPU	Depth-duration-frequency curves derived from FEH CD-ROM, from centre of each 5km model, with areal reduction factor applied to convert point rainfall estimate to more representative figure. Curve then used to derive 1.1 hr, 1:200 chance rainfall depth; this is converted to hyetograph, using summer rainfall profile. See "Description of assessment method" for allowances for infiltration and drainage.	Rainfall Hyetograph, EA 2m Composite DTM, OSMM Topography	Unmarked		UKE09000027F0007
Data updated quarterly. To understand the likelihood of future flooding, taking account of defences, refer to Areas Benefitting from Defences and National Flood Risk Assessment (NaFRA) data. Marked 'Protect' for complete national dataset only	Environment Agency	Medium	2010-11	Varies but mainly JFLOW, ISIS, HEC-RAS, TUFLOW for fluvial, and HYDROF for tidal.	National methodology described in "National Generalised Modelling for Flood Zones - Fluvial & Tidal Modelling Methods - Methodology, Strengths and Limitations". A national dataset (for England and Wales) of fluvial flood peak estimates was derived from the Flood Estimation Handbook (FEH) to generate a 1 in 100 chance fluvial flood. Local fluvial modelling uses FEH methods. Peak tidal water levels from either Dixon & Tawn (DT3) or local data sets to derive 1 in 200 chance tide levels including surge from POL CSX model.	NextMap SAR DTMe, UKHO Admiralty Charts, 1:50K CEH River Centre Line, CEH FEH Q(T) Grids, POL CSX Peak Extreme Water Levels, POL CS3 Astronomical Tides, UKHO Admiralty Tide Time-Series Calibration Locations, OS 1:10 Boundary Line MHW	Protect	Commercial	UKE09000027F0008

Data updated quarterly. To understand the likelihood of future flooding, taking account of defences, refer to National Flood Risk Assessment (NaFRA) data. Marked 'Protect' for complete national dataset only.	Environment Agency	Medium	2010-11	Varies but mainly JFLOW, ISIS, HEC-RAS, TUFLOW for fluvial, and HYDROF for tidal.	National methodology described in "National Generalised Modelling for Flood Zones - Fluvial & Tidal Modelling Methods - Methodology, Strengths and Limitations". A national dataset (for England and Wales) of fluvial flood peak estimates was derived from the Flood Estimation Handbook (FEH) to generate a 1 in 1000 chance fluvial flood. Local fluvial modelling uses FEH methods. Peak tidal water levels from either Dixon & Tawn (DT3) or local data sets to derive 1 in 1000 chance tide levels including surge from POL CSX model.	NextMap SAR DTMe, UKHO Admiralty Charts, 1:50K CEH River Centre Line, CEH FEH Q(T) Grids, POL CSX Peak Extreme Water Levels, POL CS3 Astronomical Tides, UKHO Admiralty Tide Time-Series Calibration Locations, OS 1:10 Boundary Line MHW, Historic	Protect	Commercial	UKE09000027F0009
Modelling produced as part of the Drain London Project delivering SWMPs and PFRAs for all 33 London Boroughs.	Greater London Authority	Medium	2010-11	TUFLOW	Depth-duration-frequency curves derived from FEH CD-ROM from centre of 10km2 grid squares covering Greater London. Curve used to derive 3hr storm duration 1:200 chance rainfall event, Converted to hyetograph using summer rainfall profile.	Rainfall Hyetograph, EA 1m Composite DTM, OSMM Topography	Restricted	Commercial	UKE09000027F0010
Modelling produced as part of the Drain London Project delivering SWMPs and PFRAs for all 33 London Boroughs.	Greater London Authority	Medium	2010-11	TUFLOW	Depth-duration-frequency curves derived from FEH CD-ROM from centre of 10km2 grid squares covering Greater London. Curve used to derive 3hr storm duration 1:200 chance rainfall event, Converted to hyetograph using summer rainfall profile.	Rainfall Hyetograph, EA 1m Composite DTM, OSMM Topography	Restricted	Commercial	UKE09000027F0011
Modelling produced as part of the Drain London Project delivering SWMPs and PFRAs for all 33 London Boroughs.	Greater London Authority	Medium	2010-11	TUFLOW	Depth-duration-frequency curves derived from FEH CD-ROM from centre of 10km2 grid squares covering Greater London. Curve used to derive 3hr storm duration for 1:100 chance+30% CC rainfall event. Converted to hyetograph using summer rainfall profile.	Rainfall Hyetograph, EA 1m Composite DTM, OSMM Topography	Restricted	Commercial	UKE09000027F0012
Modelling produced as part of the Drain London Project delivering SWMPs and PFRAs for all 33 London Boroughs.	Greater London Authority	Medium	2010-11	TUFLOW	Depth-duration-frequency curves derived from FEH CD-ROM from centre of 10km2 grid squares covering Greater London. Curve used to derive 3hr storm duration for 1:100 chance+30% CC rainfall event. Converted to hyetograph using summer rainfall profile.	Rainfall Hyetograph, EA 1m Composite DTM, OSMM Topography	Restricted	Commercial	UKE09000027F0013

Data developed specifically for Drain London PFRAs and SWMPs, and is unlikely to be suitable for any other purposes.	Medium-Low	2010-11	ArcGIS	The following four data sources have been utilised to produce the iPEG map: • BGS Groundwater Flood Susceptibility Map; • Jacobs Groundwater Emergence Maps; • JBA Groundwater Flood Map; • EA/Jacobs Thames Estuary 2100 groundwater hazard maps.	Restricted	UKE09000027F0014

Annex 3 – Flood Risk Areas

Please refer to Annex 3 of the Preliminary Assessment Spreadsheet.

ANNEX 3: Records of Flood Risk Areas and their rationale (preliminary assessment report spreadsheet)

Field:	Flood Risk Area ID	Name of Flood Risk Area	National Grid Reference	Main source of flooding	Additional source(s) of flooding	Confidence in main source of flooding	Main mechanism of flooding	Main characteristic of flooding
Mandatory / optional:	**Mandatory**	**Mandatory**	**Mandatory**	**Mandatory**	Optional	Optional	**Mandatory**	**Mandatory**
Format:	Unique number between 1-9999	Max 250 characters	12 characters: 2 letters, 10 numbers	Pick from drop-down	Max 250 characters, same source terms	Pick from drop-down	Pick from drop-down	Pick from drop-down
Notes:	A sequential number starting at 1 and incrementing by 1 for each record.	Name of the locality associated with the Flood Risk Area; a town, city, or county.	National Grid Reference of the centroid (centre point, falls within polygon) of the Flood Risk Area.	Pick the source from which there is a significant flood risk. Refer to the PFRA guidance for definitions of sources.	If there is also significant flood risk generated by another source (other than the Main source of flooding), report the source(s) here, using the same source terms.	Pick a broad level of confidence in the Main source of flooding from; 'High' (compelling evidence of source - about 80% confident that source is correct), 'Medium' (some evidence of source but not compelling - about 50% confident that source is correct) 'Low' (source assumed - about 20% confident that source is correct) or 'Unknown'.	Pick a mechanism from; 'Natural exceedance' (of capacity), 'Defence exceedance' (floodwater overtopping defences), 'Failure' (of natural or artificial defences or infrastructure, or of pumping), 'Blockage or restriction' (natural or artificial blockage or restriction of a conveyance channel or system), or 'No data'.	Pick a characteristic from; 'Flash flood' (rises and falls quite rapidly with little or no advance warning), 'Natural flood' (due to significant precipitation, at a slower rate than a flash flood), 'Snow melt flood' (due to rapid snow melt), 'Debris flow' (conveying a high degree of debris), or 'No data'. Most UK floods are 'Natural floods'.
Example:	1	London	SX1234512345	Surface runoff	NA	High	Natural exceedance	Natural flood
Records begin here:	1	London	TQ3276278392	Surface runoff	NA	High	Natural exceedance	Natural flood

Significant consequences to human health	Human health consequences - residential properties	Property count method	Other human health consequences	**Significant economic consequences**	Number of non-residential properties flooded	Property count method	Other economic consequences	**Significant consequences to the environment**	Environment consequences	**Significant consequences to cultural heritage**	Cultural heritage consequences
Mandatory	Optional	Optional	Optional	**Mandatory**	Optional	Optional	Optional	**Mandatory**	Optional	**Mandatory**	Optional
Pick from drop-down	Number between 1-10,000,000	Pick from drop-down	Max 250 characters	Pick from drop-down	Number between 1-10,000,000	Pick from drop-down	Max 250 characters	Pick from drop-down	Max 250 characters	Pick from drop-down	Max 250 characters
Has the Flood Risk Area been identified as a result of significant consequences to human health?	Record the number of residential properties where the building structure would be affected either internally or externally by the flood.	Where residential or non-residential properties have been counted, it is important to record the method of counting, to aid comparisons between counts. Choose from; 'Detailed GIS' (using property outlines, as per Environment Agency guidance), 'Simple GIS' (using property points), 'Estimate from map', or 'Observed number'.	If the Flood Risk Area has been identified as a result of other Significant consequences to human health, describe them (such as information about the number of critical services flooded).	Has the Flood Risk Area been identified as a result of significant economic consequences?	Record the number of non-residential properties where the building structure would be affected either internally or externally by the flood.	Where residential or non-residential properties have been counted, it is important to record the method of counting, to aid comparisons between counts. Choose from; 'Detailed GIS' (using property outlines, as per Environment Agency guidance), 'Simple GIS' (using property points), 'Estimate from map', or 'Observed number'.	If the Flood Risk Area has been identified as a result of other Significant economic consequences, describe them (such as information about the area of agricultural land flooded, length of roads and rail flooded).	Has the Flood Risk Area been identified as a result of significant consequences to the environment?	If the Flood Risk Area has been identified as a result of Significant consequences to the environment, describe them (such as information about national and international designated sites flooded, and pollution sources flooded).	Has the Flood Risk Area been identified as a result of significant consequences to cultural heritage?	If the Flood Risk Area has been identified as a result of Significant consequences to cultural heritage, describe them (such as information about the number and type of heritage assets flooded).
Yes	50000	Detailed GIS		No				No		No	
Yes	50000	Detailed GIS		No				No		No	

Origin of Flood Risk Area	Amended Flood Risk Area rationale	New Flood Risk Area rationale	Rationale detail	European Flood Risk Area Code
Mandatory	**Mandatory**	**Mandatory**	**Mandatory**	Auto-populated
Pick from drop-down	Pick from drop-down	Pick from drop-down	Max 1,000 characters	Max 42 characters
Pick the origin from either; 'Indicative' Flood Risk Area, 'Amended' Flood Risk Area (in which case Amended Flood Risk Area rationale is mandatory), or 'New' Flood Risk Area (in which case New Flood Risk Area rationale is mandatory).	Pick the main rationale from either; 'Geography', 'Past floods', or 'Future floods'. Then provide further detail in Rationale detail. This is not mandatory if the Flood Risk Area was an indicative Flood Risk Area and has not been amended, or is a new Flood Risk Area.	Pick the main rationale from either 'Past floods', or 'Future floods'. Then provide further detail in Rationale detail. This is not mandatory if the Flood Risk Area was an indicative Flood Risk Area.	Summarise the rationale for amending an indicative Flood Risk Area, or identifying a new Flood Risk Area. Refer to Defra & WAG guidance to LLFAs on "Selecting and reviewing Flood Risk Areas for local sources of flooding". If the Flood Risk Area was an indicative Flood Risk Area and has not been amended, record "indicative Flood Risk Area".	This field will autopopulate using the LLFA name provided on the "Instructions" tab, and the Flood Risk Area ID. It is an EU-wide unique identifier and will be used to report the Flood Risk Area information. Format: UK<ONS Code><A><LLFA Flood ID>. "ONS Code" is a unique reference for each LLFA. "A" indicates it is a Flood Risk Area. "LLFA Flood ID" is a sequential number beginning with 0001.
Indicative	NA	NA	indicative Flood Risk Area	UKE10000012A0001
Indicative	NA	NA	Indicative Flood Risk Area	UKE09000027A0001

Annex 4 – Review Checklist

Preliminary Flood Risk Assessment Checklist					
LLFA Name:					
Checklist questions		**Notes for completion**	**LLFA**	**Environment Agency area review**	**Environment Agency national review**
Step 1	**Set up governance and develop partnerships**				
1.1	Have appropriate governance and partnership arrangements been set up?	Refer to section 2.3 of guidance. Governance and partnership arrangements should be to the satisfaction of the LLFA.	Yes		
1.2	Who in the LLFA reviewed the PFRA and when was it done?	Please state the review and approval process and when approval was gained e.g. Officer, Scrutiny Committee, Cabinet. Refer to Section 5 of the guidance.			
Step 2	**Determine appropriate data systems**				
2.1	Has a data management system been established and implemented?	See Annex 5 for information about data standards	No		
Step 3	**Collate information on past and future floods and their consequences**				
3.1	Has information been requested from all relevant partners?	See Flood Risk Regulations Part 6 Co-operation.	Yes		
3.2	Are there any gaps in available information? (This could include gaps which could have been filled but weren't, or gaps which couldn't be filled because the information wasn't available)	LLFAs - Are there gaps in certain locations, or for certain events that you are aware of, or for certain sources of flooding (such as groundwater). Respond with Yes/No and provide comments on any missing information. EA Review - Has all available information has been gathered and included?	Yes - All available datasets were collated, but flood records are not comprehensive with respect to the type of data recorded and the impacts of the event. There are no available details on local		
Step 4	**Determining locally agreed surface water information**				
4.1	Which dataset (or combination of datasets) has been determined as "locally agreed surface water information"?	LLFAs - Select from drop down. Refer to "Locally agreed surface water information" text box in section 3.5.1 (p.17) of guidance. EA review - Has this been agreed?	Other local information		
4.2	Has the locally agreed surface water information been clearly stated and presented (on a map) in the Preliminary Assessment Report?	LLFAs - Select Yes/No from drop down list. Refer to "locally agreed surface water information" text box in section 3.5.1 (p.17) of guidance.	Yes		
4.3	If available, what is the total property count for locally agreed surface water information in the LLFA?	If known, please enter the total number of properties at risk in the LLFA.	30,940 (1 in 200 annual chance of occurrence in any given year 0.5% AEP)		
4.4	If applicable, has the method for counting properties been described in the Preliminary Assessment Report?	Refer to text box on page 17 of guidance	No		
4.5	Has available information on local drainage capacity (where used to inform the determination of locally agreed surface water information) been included in the report?	Refer to text box on page 17 of guidance. Information provided on drainage may inform options for any future improvements to the Flood Map for Surface Water.	No		

Preliminary Flood Risk Assessment Checklist					
LLFA Name:					
	Checklist questions	**Notes for completion**	**LLFA**	**Environment Agency area review**	**Environment Agency national review**
Step 5	**Complete Preliminary Assessment Report Document**				
5.1	Does the Preliminary Assessment Report cover all the content described in Annex 1 of the Environment Agency's PFRA guidance?	LLFAs - If the Preliminary Assessment Report contains all the content described in Annex 2 of the PFRA guidance, respond with a 'Yes'. If there are some elements missing, please provide a brief explanation. EA Review - Include comments on any missing content.	Yes		
5.2	Has a summary table of flood events been produced?	Refer to section 3.4 and 3.5 of guidance	Yes		
5.3	Has a description of past flood events been included?	Refer to section 3.4 and 3.5 of guidance	Yes		
5.4	Has additional information been included on climate change and long term developments?	Refer to 3.6 of guidance. Standard text has been provided for Preliminary Assessment Reports which meets the minimum requirements of the Flood Risk Regulations. Please respond with Yes or No, and if additional information has been included, please state the information source(s)	Yes - information has been provided on areas of major development in Sutton alongside property count and Food Depth and Hazard maps provided from the Drain London 1 in 100 Year + Climate Change (+30%) pluvial		
Step 6	**Record information on past and future floods with significant consequences in spreadsheet**				
6.1	Are records of past flooding with significant harmful consequences recorded on the Preliminary Assessment Report spreadsheet (Annex 1 of Prelminary Assessment Report) ?	LLFAs - past flooding should be recorded on the spreadsheet and included as Annex 1 of the Preliminary Assessment Report. EA review - Are all the mandatory fields complete?	Yes		
6.2	Are there any past floods with significant harmful consequences that have not been recorded? If so, please explain why not.	LLFAs - Respond with Yes or No. If No, provide additional information e.g. anecdotal information on flood, but not enough evidence to include EA review - Do you agree with LLFA response and comments?	Yes - anecdotal information on other flood events, but not enough to conclude whether they had significant harmful consequences.		
6.3	Have any additional records of future flooding (other than the national dataset information which is already completed) been recorded on the future flooding Preliminary Assessment Report spreadsheet (Annex 2 of Preliminary Assessment Report)	LLFAs - future flooding information should be recorded on the spreadsheet and included as Annex 2 of the Preliminary Assessment Report. EA review - Are all mandatory fields complete?	Yes		
Step 7	**Illustrate information on past and future floods**				
7.1	Have summary maps been produced for past and future floods?	Refer to section 3.4 and 3.5 of guidance	Yes		
Step 8	**Review indicative Flood Risk Areas**				
8.1	Is your LLFA within an indicative Flood Risk Area?	Indicative Flood Risk Areas were provided to LLFAs by the Environment Agency in December 2010.	Yes		
8.2	If the answer to 8.1 is yes, have you reviewed it using the locally agreed surface water information, and relevant local information in the Preliminary Assessment Report?	Refer to section 4 of guidance. LLFAs should identify whether they have reviewed against local information or just used the indicative Flood Risk Area information provided by the Environment Agency.	Yes		

Preliminary Flood Risk Assessment Checklist					
LLFA Name:					
	Checklist questions	**Notes for completion**	**LLFA**	**Environment Agency area review**	**Environment Agency national review**
Step 9	**Identify Flood Risk Areas**				
9.1	Is a Flood Risk Area proposed?	LLFA - select a response from the drop down list and then complete the relevant questions 9.1.1 - 9.1.5. (NB. Indicative Flood Risk Areas can be amended due to Geography, past flooding and/or future flooding.)	Yes - it is exactly the same as the indicative Flood Risk Area (go to question 9.1.1)		
9.1.1	If the proposed Flood Risk Area is exactly the same as the indicative Flood Risk Area, please confirm.	LLFA - please confirm that the boundary of the indicative Flood Risk Area has not been changed and no change has been made to the flood risk indicators. EA review - please confirm	Yes		
9.1.2	If changes have been made to the indicative Flood Risk Area because of geography, please identify what changes have been made.	Use the drop down list to identify the reasons for the change. Options are the same as the table on page 26 of the PFRA guidance. EA review - please confirm evidence supports change			
9.1.3	If changes have been made to the indicative Flood Risk Area because of past / historic flooding, please indicate the changes and the reasons why.	LLFA - identify the scale of the changes made e.g. major/minor increase or decrease in size of Flood Risk Area and the source of information used e.g. records of historic flooding. EA review - confirm scale of the changes made and provide indication of confidence in the evidence provided e.g. anecdotal evidence versus detailed report on flooding event.			
9.1.4	If changes have been made to the indicative Flood Risk Areas because of future flooding, please indicate the changes and the reasons why.	LLFA - identify the scale of the changes made e.g. major/minor increase or decrease in size of Flood Risk Area and the source of information used e.g. detailed modelling as part of SWMP. EA review - confirm scale of the changes made and indication of confidence in the evidence			
9.1.5	If a new Flood Risk Area is being proposed, does it meet the Defra / WAG thresholds?	Criteria and thresholds are set out in the Defra/WAG guidance on selecting and reviewing Flood Risk Areas for local sources of flooding EA review - identify the evidence provided to support this and indicate degree of confidence in the evidence.			
9.2	Does the proposed Flood Risk Area include flooding from interactions with main river, reservoirs or the sea?	LLFAs should respond with Yes or No. EA Review - Summarise the location and nature of interactions i.e. river or sea.	Yes		
9.3	Has an indicative Flood Risk Area been deleted?	LLFA - Respond with Yes/No and if an indicative Flood Risk Area has been deleted please provide a short description why. EA - confirm the evidence presented to support this is aligned to 'locally agreed surface water information'	No		
Step 10	**Record information including rationale - ONLY COMPLETE IF ANSWER TO 9.1 IS YES**				
10.1	If proposing Flood Risk Areas, have the mandatory fields in the spreadsheet been completed?	LLFAs - the spreadsheet indicates mandatory columns to be completed. EA Review - Are all mandatory fields complete?	Yes		
10.2	Has a rationale and evidence for amending/adding/deleting Flood Risk Areas been included in the Preliminary Assessment Report?	LLFAs - Refer to Table 5 on page 26 of the PFRA guidance and Annexes A-D of the Defra/WAG Guidance. Rationale should be included in "Identification of Flood Risk Areas" section of Preliminary Assessment Report. EA Review - Confirm that supporting evidence for any amendments/additions/deletions has been provided in the Preliminary Assessment Report and annexes	N/A		

Annex 5 – GIS Layer of Flood Risk Areas

Indicative flood risk areas based on clusters formed from all 3km squares that contain 5 or more Places above the Flood Risk Thresholds (1km squares) that are touching.

Indicative flood risk areas are labelled with their location and the number of people at risk. Clusters with fewer than 30,000 people at risk have not been designated as indicative flood risk areas.

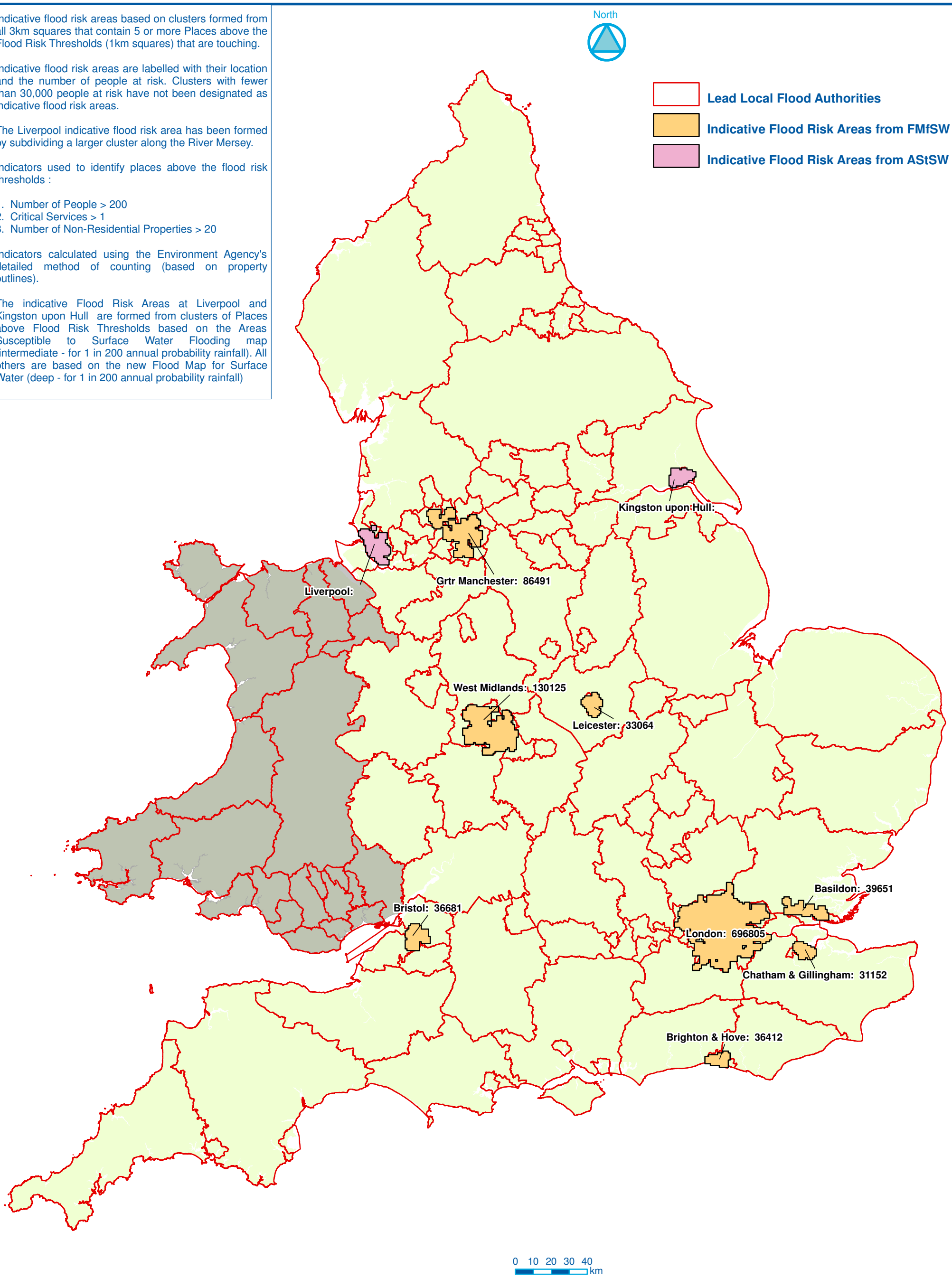
The Liverpool indicative flood risk area has been formed by subdividing a larger cluster along the River Mersey.

Indicators used to identify places above the flood risk thresholds :

1. Number of People > 200
2. Critical Services > 1
3. Number of Non-Residential Properties > 20

Indicators calculated using the Environment Agency's detailed method of counting (based on property outlines).

The indicative Flood Risk Areas at Liverpool and Kingston upon Hull are formed from clusters of Places above Flood Risk Thresholds based on the Areas Susceptible to Surface Water Flooding map (intermediate - for 1 in 200 annual probability rainfall). All others are based on the new Flood Map for Surface Water (deep - for 1 in 200 annual probability rainfall)



Indicative Flood Risk Areas for England

These are to be used by Lead Local Flood Authorities as part of the process for identifying Flood Risk Areas under the Flood Risk Regulations as set out in the Environment Agency and Defra & WAG guidance on PFRAs.

Drawn by:	Peter Robinson
Date:	15/12/2010
Status:	DRAFT
File Name:	...\ArcGIS\Projects\IFRA Maps England.mxd
Drawing Number:	IFRA_EE

Scale: 1:2,000,000

Original @ A3

Environment Agency

Annex 6 – Mapping

1 Surface Water & Fluvial Flooding Incidents

2 Groundwater Flooding Incidents & increased Potential for Elevated Groundwater (iPEG)

3 Sewer Flooding Incidents

4 Maximum Flood Depth – 1 in 200 chance of rainfall event occurring in any given year (0.5% AEP)

5 Flood Hazard – 1 in 200 chance of rainfall event occurring in any given year (0.5% AEP)

6 Maximum Flood Depth – 1 in 100 chance of rainfall event occurring in any given year (1%) plus Climate Change

7 Flood Hazard – 1 in 100 chance of rainfall event occurring in any given year (1%) plus Climate Change

THIS DRAWING MAY BE USED ONLY FOR THE PURPOSE INTENDED

NORTH

London Borough of Hounslow

London Borough of Wandsworth

London Borough of Merton

Royal Borough of Kingston upon Thames

0 0.25 0.5 1 2 Kilometres

Legend

- Borough Administrative Boundary
- Fluvial Flooding Incidents
- Surface Water Flooding Incidents

London Borough of Richmond

LONDON BOROUGH OF RICHMOND UPON THAMES

Preliminary Flood Risk Assessment

Scale at A3	Date	Drawn by	Approved by
1:45,000	13/05/2011	D.SKILTON	E.CRAVEN

Surface Water Flooding Incidents and Fluvial Flooding Incidents

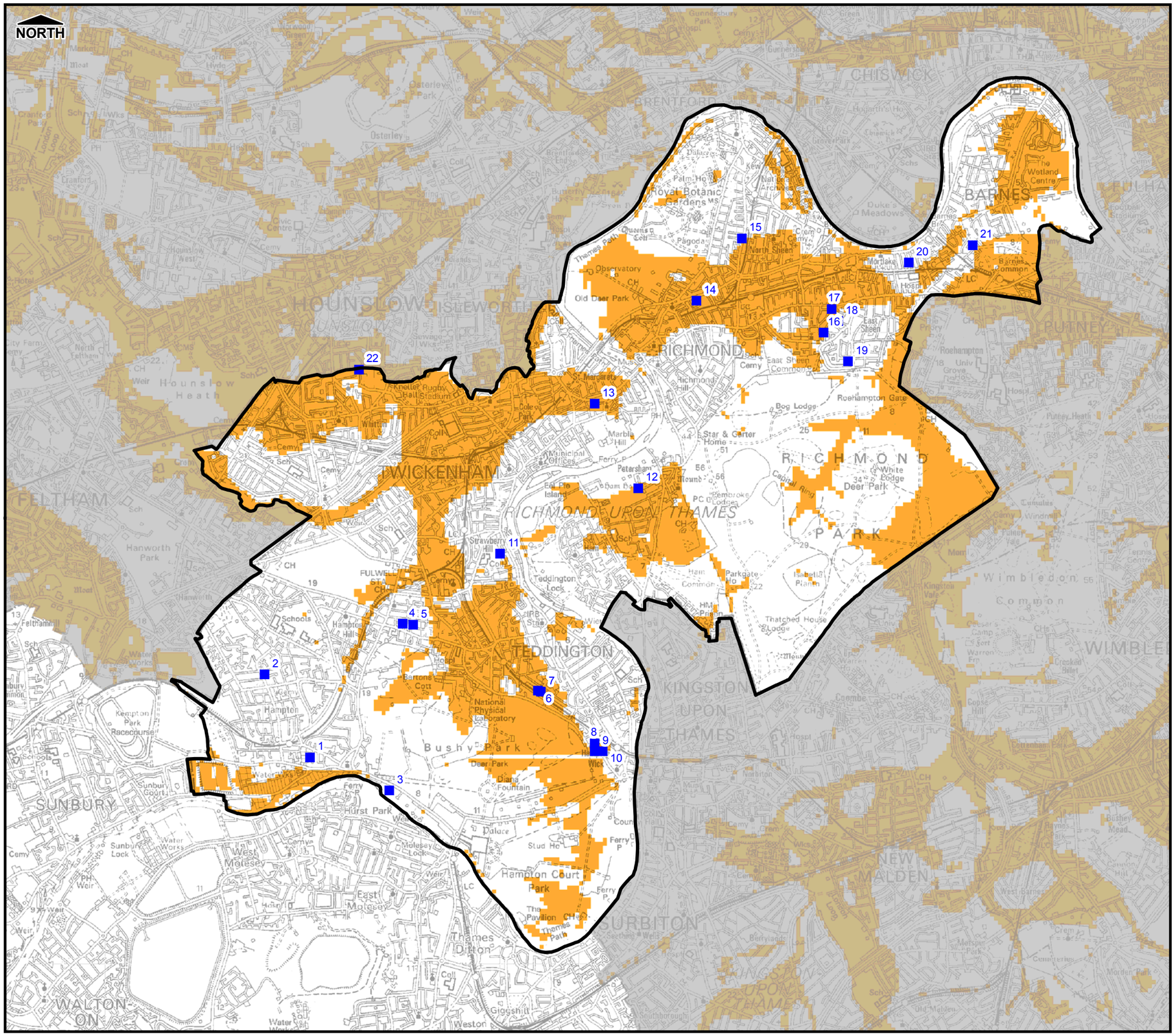
Consultants
CAPITA SYMONDS Flood Risk Management
Scott Wilson
URS / Scott Wilson
6 - 8 Greencoat Place
London
SW1P 1PL

Drain London Programme Board Members

Environment Agency · Thames Water · LONDON COUNCILS · GREATERLONDONAUTHORITY

FIGURE 1

Filepath: N:\Water\Current Projects\D134785 D134786 DRAIN LONDON Tier 2\02 Group 8 (D134786)\05 GIS



THIS DRAWING MAY BE USED ONLY FOR THE PURPOSE INTENDED

Legend

- Richmond Borough Council
- Groundwater Flood Incident (EA Records)

Increased Potential for Elevated Groundwater in

- Permeable Superficial Deposits
- Consolidated Aquifers

Notes

1.The increased Potential for Elevated Groundwater map shows those areas within the London Boroughs where there is an increased potential for groundwater to rise sufficiently to interact with the ground surface or be within 2m of the groundsurface. Such groundwater rise could lead to the following:

-Flooding of basements of buildings below ground level;
-Flooding of buried services or other assets below ground level;
-Inundation of farmland, roads, commercial, residental and amenity areas;
-Flooding of ground floors of buildings above ground level; and Overflowing of sewers and drains

2.Incident records shown are generally unconfirmed and may include issues such as water main bursts or non-groundwater related problems.
3.Areas not shown to have increased potential for elevated groundwater should be considered to have a low potential for elevated groundwater - Lack of information does not imply 'no potential' of elevated groundwater in that area.
4.Includes groundwater flood mapping provided by JBA consulting, Copyright. Jeremy Benn Associates Limited 2008-2011, partially derived from data supplied by the Environment Agency.

London Borough Richmond

LONDON BOROUGH OF RICHMOND UPON THAMES

Preliminary Flood Risk Assessment

Scale at A3	Date	Drawn by	Approved by
1:50,000	22/03/2011	C.Woolhouse	S.Cox

Increased Potential For Elevated Groundwater

Consultants
CAPITA SYMONDS Flood Risk Management
Scott Wilson
URS / Scott Wilson
6 - 8 Greencoat Place
London
SW1P 1PL

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FIGURE 2

Filepath: D:\134786 Drain London_Tier 2_Group 8\700 Technical\711 GIS\01 Layout\Richmond\Increased Potential for Elevated GW.mxd

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NORTH

TW8 0
TW9 3
TW9 4
TW9 2
TW9 1
SW138
SW139
SW130
SW151
SW147
SW148
SW156
SW155
SW154
SW153
TW106
TW105
TW107
TW1 1
TW1 2
TW1 3
TW1 4
TW3 2
TW7 7
TW4 5
TW2 7
TW2 6
TW2 5
TW136
TW121
TW123
TW118
TW119
TW110
TW165
TW122
KT2 5
KT2 7
KT1 4
KT8 9
KT8 1
KT7 0

London Borough of Hounslow
London Borough of Wandsworth
London Borough of Merton
Royal Borough of Kingston upon Thames

RICHMOND
RICHMOND UPON THAMES
PARK
BARNES
TWICKENHAM
TEDDINGTON

0 0.25 0.5 1 2 Kilometres

Legend

- Borough Administrative Boundary
- Sewer Flooding Incidents

No. of Sewer Flood Records

- None
- 1 - 5
- 6 - 10
- 11 - 20
- 21 - 50
- 51 - 100
- 101+

Notes

1. Sewer flood records relate to internal and external flooding of properties
2. Data supplied by Thames Water Ltd and is correct as at June 2010
3. Point data supplied by Borough Council

London Borough of Richmond

LONDON BOROUGH OF RICHMOND UPON THAMES

Preliminary Flood Risk Assessment

Scale at A3	Date	Drawn by	Approved by
1:45,000	13/05/2011	D.SKILTON	E.CRAVEN

Sewer Flooding Incidents

Consultants
CAPITA SYMONDS Flood Risk Management
Scott Wilson
URS / Scott Wilson
6 - 8 Greencoat Place
London
SW1P 1PL

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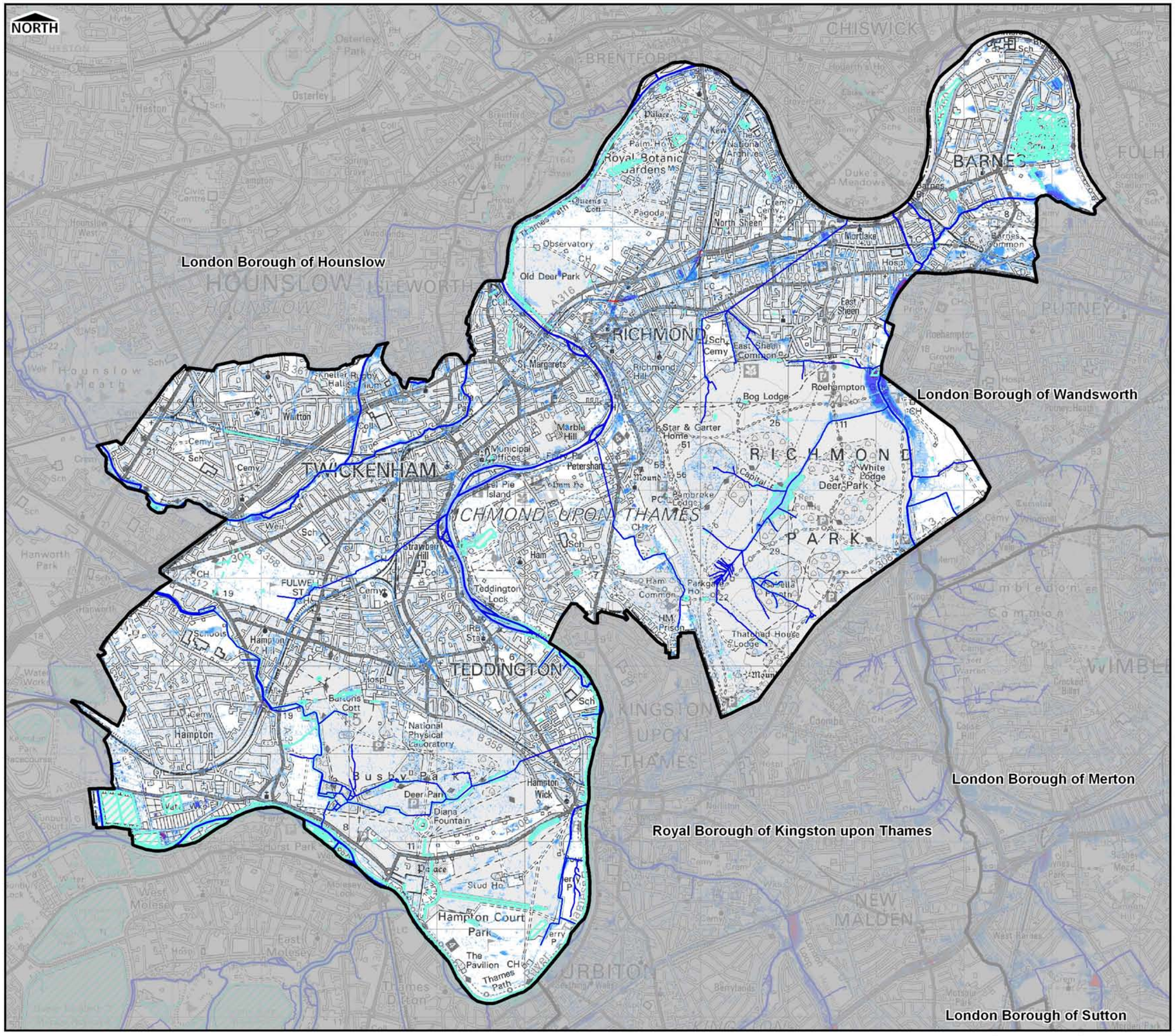
FIGURE 3

Filepath: N:\Water\Current Projects\D134785 D134786 DRAIN LONDON Tier 2\02 Group 8 (D134786)\05 GIS



THIS DRAWING MAY BE USED ONLY FOR THE PURPOSE INTENDED

Legend

- Borough Administrative Boundary
- Permanent Water Bodies
- Main River
- Ordinary Watercourse

Flood Depth

- <0.1m
- 0.1m to 0.25m
- 0.25m to 0.5m
- 0.5m to 1.0m
- 1.0m to 1.5m
- >1.5m

Notes

1. This map only shows the predicted likelihood of surface water flooding (this includes flooding from sewers, drains, small watercourses and ditches that occurs in heavy rainfall) for defined areas, and due to the coarse nature of the source data used, are not detailed enough to account for precise addresses.
2. Users of this map should refer to section 3.2 of the Surface Water Management Plan for a complete description of limitations and accuracy of the flood/hazard extents shown.
3. This map provides a strategic overview of surface water flood risk and may be subject to further analysis in the future.

London Borough of Richmond

LONDON BOROUGH OF RICHMOND UPON THAMES

Preliminary Flood Risk Assessment

Scale at A3	Date	Drawn by	Approved by
1:45,000	13/05/2011	D.SKILTON	J.ROBINSON

Surface Water Depth (m) 1 in 200 Chance of rainfall event occuring in any given year (0.5% AEP)

Consultants
CAPITA SYMONDS Flood Risk Management
Scott Wilson
URS / Scott Wilson
6 - 8 Greencoat Place
London
SW1P 1PL

Drain London Programme Board Members

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FIGURE 4

Filepath: N:\Water\Current Projects\D134785 D134786 DRAIN LONDON Tier 2\02 Group 8 (D134786)\05 GIS

THIS DRAWING MAY BE USED ONLY FOR THE PURPOSE INTENDED

NORTH

London Borough of Hounslow

London Borough of Wandsworth

London Borough of Merton

Royal Borough of Kingston upon Thames

0 1 2km

Legend

- Borough Administrative Boundary
- Permanent Water Bodies
- Main River
- Ordinary Watercourse

Flood Hazard

- <0.75 Caution (Very low hazard)
- 0.75 - 1.25 Moderate (Danger for some)
- 1.25 - 2.0 Significant (Danger for most)
- <2.0 Extreme (Danger for all)

Notes

1. Flood Hazard has been defined based upon the joint EA and Defra R&D Technical Report FD2320 (January 2006).
2. Degree of flood hazard can be interpreted as follows:
- Caution: Flood zone with shallow flowing water or deep standing water
- Moderate: Flood zone with deep or fast flowing water. Dangerous for children, the elderly and the infirm
- Significant: Flood zone with deep fast flowing water. Dangerous for most people.
- Extreme: Flood zone with deep fast flowing water. Dangerous for all (including emergency services)

London Borough of Richmond

LONDON BOROUGH OF RICHMOND UPON THAMES

Preliminary Flood Risk Assessment

Scale at A3	Date	Drawn by	Approved by
1:45,000	13/05/2011	D.SKILTON	J.ROBINSON

Surface Water Flood Hazard Rating
1 in 200 Chance of rainfall event occuring in any given year (0.5% AEP)

Consultants
CAPITA SYMONDS Flood Risk Management
Scott Wilson
URS / Scott Wilson
6 - 8 Greencoat Place
London
SW1P 1PL

Drain London Programme Board Members

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FIGURE 5

Filepath: N:\Water\Current Projects\D134785 D134786 DRAIN LONDON Tier 2\02 Group 8 (D134786)\05 GIS

NORTH

London Borough of Hounslow

London Borough of Wandsworth

London Borough of Richmond

London Borough of Merton

Royal Borough of Kingston upon Thames

0 1 2km

Legend

- Borough Administrative Boundary
- Permanent Water Bodies
- Main River
- Ordinary Watercourse

Flood Depth

- <0.1m
- 0.1m to 0.25m
- 0.25m to 0.5m
- 0.5m to 1.0m
- 1.0m to 1.5m
- >1.5m

Notes

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3. This map provides a strategic overview of surface water flood risk and may be subject to further analysis in the future.

London Borough of Richmond

LONDON BOROUGH OF RICHMOND UPON THAMES

Preliminary Flood Risk Assessment

Scale at A3	Date	Drawn by	Approved by
1:45,000	13/05/2011	D.SKILTON	J.ROBINSON

Surface Water Depth (m) 1 in 100 Chance of rainfall event occuring in any given year (1% AEP) plus Climate Change

Consultants
CAPITA SYMONDS Scott Wilson
Flood Risk Management
URS / Scott Wilson
6 - 8 Greencoat Place
London
SW1P 1PL

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FIGURE 6

Filepath: N:\Water\Current Projects\D134785 D134786 DRAIN LONDON Tier 2\02 Group 8 (D134786)\05 GIS

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NORTH

London Borough of Hounslow

London Borough of Wandsworth

London Borough of Merton

Royal Borough of Kingston upon Thames

0 1 2km

Legend

- Borough Administrative Boundary
- Permanent Water Bodies
- Main River
- Ordinary Watercourse

Flood Hazard

- <0.75 Caution (Very low hazard)
- 0.75 - 1.25 Moderate (Danger for some)
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- Significant: Flood zone with deep fast flowing water. Dangerous for most people.
- Extreme: Flood zone with deep fast flowing water. Dangerous for all (including emergency services)

London Borough of Richmond

LONDON BOROUGH OF RICHMOND UPON THAMES

Preliminary Flood Risk Assessment

Scale at A3	Date	Drawn by	Approved by
1:45,000	13/05/2011	D.SKILTON	J.ROBINSON

Surface Water Flood Hazard Rating 1 in 100 Chance of rainfall event occuring in any given year (1% AEP) plus Climate Change

Consultants
CAPITA SYMONDS Flood Risk Management
Scott Wilson
URS / Scott Wilson
6 - 8 Greencoat Place
London
SW1P 1PL

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FIGURE 7

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Strategic Flood Risk Assessment - Level 1

Prepared for the London Borough of Richmond upon Thames

Created by Damon Reid-Williams
Approved by Mike Mair
Date March 2021
Version 1.3

Metis Consultants Ltd.
Spencer House
23 Sheen Road, Richmond
London, TW9 1BN
United Kingdom
t. 020 8948 0249
e. info@metisconsultants.co.uk
w. metisconsultants.co.uk

Revision History

Version	Date	Description	Prepared	Approved
1.0	March 2020	First Draft	DR-W	MM
1.1	August 2020	Final Draft for Client Review	DR-W	MM
1.2	September 2020	Final Report	DR-W	MM
1.3	March 2021	Final Report – Subterranean Updates	DR-W	MM

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Contact Details

Metis Consultants Ltd.
Spencer House
23 Sheen Road, Richmond
London, TW9 1BN
t. 020 8948 0249
e. info@metisconsultants.co.uk
w. metisconsultants.co.uk

EXECUTIVE SUMMARY

The London Borough of Richmond upon Thames is subject to fluvial and tidal flooding from the River Thames. As the only borough to span both sides of the Thames, a large number of properties are potentially at risk of flooding from the River Thames and its tributaries. The borough is also at risk of flooding from other flood risk sources, including surface water and groundwater influenced flooding.

The purpose of this Level 1 Strategic Flood Risk Assessment (SFRA) is to deliver the planning and flood risk requirements as defined by the 2019 National Planning Policy Framework (NPPF). This SFRA supersedes the 2016 SFRA, enabling Richmond upon Thames to be compliant with the latest policy requirements and utilise the latest data to better assess flood risk.

The SFRA provides a strategic overview of all forms of flood risk throughout the borough, now and in the future. This document, and the associated web-based mapping delivered as part of the SFRA, is designed to help address local requirements, manage development requirements, and manage the risk of flooding posed to both residents and buildings. The local requirements addressed as part of this SFRA include climate change impacts, localised flood issues, and specific policies and interpretations of the Flood Zones.

The document is broken down into eight sections:

- **Section 1 (Introduction)** provides an overview of the purpose and objectives of the SFRA.
- **Section 2 (Planning and Policy Framework)** provides an overview of the relevant national, regional and local policies relating to flood risk and associated requirements.
- **Section 3 (Data Sources and Mapping)** provides an overview of the web-based maps produced as part of the SFRA. The interactive maps depict the various flood risks across the study area. Further information on the SFRA web maps is found within the data sources list, which is provided as part of this document's appendices.
- **Section 4 (Applying Climate Change to Risk Assessment)** provides an overview of the Environment Agency's (EA) climate change guidance. This includes information on updates, how to apply the updated guidance, and adapting to climate change.
- **Section 5 (Assessment of Flood Risk)** provides an overview of the flood risk from all sources across the borough, including climate change implications where this information is available. This section also links to the web-based flood risk maps.
- **Section 6 (Flood Risk Assessment Guidance)** provides guidance for developers and applicants undertaking Flood Risk Assessments (FRA) for proposed development sites. This section explains the Sequential Test and Exception Test requirements per Flood Zone and includes local requirements for areas at risk of surface water flooding.
- **Section 7 (Recommendations)** provides recommendations of site-specific and strategic policies. These are based on the findings of this SFRA, which the London Borough of Richmond upon Thames is advised to incorporate into future versions of its Local Plans and/or associated policy guidance documents. An overview of the potential impact that future growth could have on flood risk across the study area is provided. An overview of property level resilience measures, emergency planning and managing residual risks in the London Borough of Richmond upon Thames is also provided.
- **Section 8 (Review and Next Steps)** provides a summary of the proposed update schedule for the SFRA (the technical content and the mapping) and information on Level 2 SFRA requirements.

Future developments and climate change are some of the key factors that are increasing the risk of flooding events across the UK and globally. Several key drivers, including urban development expansion, could see an increase in flood risk from various sources. The pressure of accommodating more developments may mean

a larger number of developments being proposed for sites within higher risk Flood Zone areas, placing them at greater risk of flooding. The impact of development and projected future population growth may not only have an impact on the flood risk presented by different flood sources, but present a greater overall flood risk to people and properties due to the accumulative risk from each source.

To meet flood risk mitigation requirements whilst facilitating housing development needs at all scales, strategic policy targeting the impact of future growth and climate change on flood risk is required. It is recommended that the London Borough of Richmond upon Thames develops and implements policy that encourages opportunities for strategic flood risk management approaches which the borough, in partnership with other organisations (including developers and water companies), can deliver to facilitate development.

Based on the assessment of flood risk and development requirements, the SFRA provides a set of policy recommendations for the London Borough of Richmond upon Thames, including the following:

Strategic Policies Recommendations

1. The London Borough of Richmond upon Thames should consider implementing the 1 in 100 year surface water extent as Flood Zone 3a (surface water) for the borough. These requirements of Flood Zone 3a (surface water) could be similar to those adopted for Flood Zone 3a (fluvial / tidal) with modifications as follows:
    a. Development within the 1 in 100 year RoFSW mapped extent will be treated as if it were Flood Zone 3a as defined in PPG Table 1 (Paragraph 065).
    b. Highly vulnerable developments may be possible within the 1 in 100 year RoFSW mapped extents outside of existing infrastructure or solid building footprints.
    c. To enable development, proposals must provide mitigation and resilience against flood risk (taking advice from the LLFA as appropriate) and provide appropriate compensation to existing flood risk levels and volumes (addressing the predicted 1 in 100 year RoFSW mapped depths as a minimum), supported by detailed flood risk modelling if appropriate.
    d. The development must not increase flood risk elsewhere and where possible reduce flood risk overall. Evidence demonstrating that all surface water is managed on site and that surface water is discharged at greenfield runoff rate (or within three times the calculated greenfield rate) is required.
2. The London Borough of Richmond upon Thames should conduct a Level 2 SFRA screening assessment based on the current allocated sites in the borough. This assessment will help inform which sites require a Level 2 SFRA. See *Section 8.2* for further Level 2 SFRA information.
3. The London Borough of Richmond upon Thames should implement measures through their Local Plan to deal with the Sequential Test acceptability of windfall site development (sites which become available for development unexpectedly) proposals at the strategic level. The measure could set out locations and quantities of windfall sites that would or would not be acceptable in Sequential Test terms (to provide input to the process defined in *Section 6.3.1*). This would help create efficiencies in the process.
4. The London Borough of Richmond upon Thames should adopt a Catchment Based Approach to ensure recognition of catchment-wide flood issues to justify the collection and use of S106 funding to investigate and develop flood alleviation schemes within the catchment the development falls within. CDAs defined by the borough SWMP (for surface water flooding) or policy sub-areas defined by EA CFMPs (for fluvial / tidal flooding) provide an established technical basis for this approach.
5. The London Borough of Richmond upon Thames should incorporate the draft London RFRA 2018 recommendations into future Local Plan policies and documents once finalised. This includes Recommendation 2 (Fluvial Flood Risk) and Recommendation 3 (Surface Water Flood Risk) which

provide recommendations in line with Policy SI 12 and Policy SI 13 respectively of the current London Plan. The recommendations are summarised as follows:

a. Recommendation 2 – Planning policies should focus on making the most of the opportunities presented by regeneration and redevelopment on river corridors to reduce fluvial flood risk through location, layout and design of development. Opportunities should also look at flood compatibility, flood resilience and maximising open space for flood water.
b. Recommendation 3 – Developments should reduce surface water discharge in line with the Sustainable Drainage Hierarchy set out in Policy SI13 of the London Plan, and the actions in the London Sustainable Drainage Action Plan (LSDAP) should also be taken.

6. The London Borough of Richmond upon Thames should make space for water storage by identifying strategic locations that are required for current and future flood risk management. These identified areas of land should be safeguarded via Local Plans to facilitate links between flood risk management and other environmental priorities. The London Borough of Richmond upon Thames should work with the LLFA and EA to identify such potential locations through flood alleviation schemes.
7. The London Borough of Richmond upon Thames should designate the following catchment areas as throughflow and groundwater policy zones as per the '*Further Groundwater Investigations*' (2020 with minor updates 2021) report:
   a. Richmond Hill (Richmond)
   b. Strawberry Hill (Twickenham)
   c. Marble Hill (Twickenham)
   d. St. Margarets West

   Subsurface structure development proposals within these zones need to fulfil site-specific requirements to demonstrate that basements, cellars, and other subsurface structures can be safely developed without increasing throughflow and groundwater related flood risk.

Site-specific Policies

1. The London Borough of Richmond upon Thames should insist that submitted FRAs utilise the 'upper end' climate change scenarios when implementing the climate change allowances for surface water and fluvial flood risk. Fluvial flood risk climate change requirements may need to be updated once EA guidance on how the 'H++' category should be applied to development management decisions has been released. Assessments of tidal flood risk should use the current TE2100 crest levels guidance and breach modelling. This would account for the worst-case scenarios.
2. The London Borough of Richmond upon Thames should ensure where possible that land within development sites are safeguarded for potential flood mitigation use through the active consideration of predicted flood mapping from all sources. This can be done as part of the planning process or as part of wider flood risk assessments such as a Level 2 SFRA.
3. Development proposed in 'dry islands' (areas within Flood Zone 1 that are surrounded by areas at higher risk of flooding, i.e. areas falling within Flood Zone 2 and 3) should be designed for safe access and egress in a flood event. 'Dry islands' are considered as flood risk areas due to the potential loss of important local services during flood events and lack of safe access routes. They require safe access and egress routes to be developed for the lifetime of the property, factoring in the impacts of climate change.
4. The London Borough of Richmond upon Thames should insist that a Screening Assessment is carried out as part of the planning application submission for all basement and cellar proposals within the throughflow and groundwater policy zones. The Screening Assessment should address the impacts of the proposed subsurface development on the area's subterranean characteristics, land stability, and flood risk and drainage. If the Screening Assessment determines that the proposed subsurface

development may have an impact on the local environment, or if it determines that further investigation work is required, then a Basement Impact Assessment is required. The impact assessment, undertaken by an appropriate chartered professional or specialist, must include, but is not limited to, the following details:

a. Detailed borehole information on or from nearby to the development site. At least two data recordings should take place within a period of at least 12 months to demonstrate any potential seasonal variations. These measurements should identify the geological conditions on or close to the development site, the infiltration potential, and the height of any groundwater.
b. Mitigation if the identified potential impacts of the proposed subsurface development are not acceptable. If, for example, the assessment identifies that the proposed development may result in water ingress to the new development and/or to neighbouring properties, then mitigation measures should be proposed to reduce and/or alleviate the risk of flooding.

To ensure that such development is feasible and will not adversely impact the site, neighbouring properties, or the wider natural environment, such assessments should be completed prior to any planning permission being granted.

CONTENTS

FIGURES AND TABLES

Acronyms and Abbreviations

Abbreviation	Definition
CDA	Critical Drainage Area
CFMP	Catchment Flood Management Plan
CIL	Community Infrastructure Levy
DEFRA	Department for Environment, Food and Rural Affairs
EA	Environment Agency
EU	European Union
FCERM	Flood and Coastal Erosion Risk Management
FRA	Flood Risk Assessment
FRMP	Flood Risk Management Plan
FRMS	Flood Risk Management Strategy
FRR	Flood Risk Regulations 2009
FWMA	Flood and Water Management Act 2010
GLA	Greater London Authority
LFRMS	Local Flood Risk Management Strategy
LLFA	Local Lead Flood Authority
LPA	Local Planning Authority
LSDAP	London Sustainable Drainage Action Plan
MHCLG	Ministry of Housing, Communities and Local Government
NPPF	National Planning Policy Framework
PFRA	Preliminary Flood Risk Assessment
PPG	Planning Practice Guidance
RFRA	Regional Flood Risk Appraisal
RMA	Risk Management Authority
RoFSW	Risk of Flooding from Surface Water
S106	Section 106 (of the Town and Country Planning Act 1990)
SFRA	Strategic Flood Risk Assessment
SuDS	Sustainable Drainage Systems
SWMP	Surface Water Management Plan
TE2100	Thames Estuary 2100 Plan
TTD	Thames Tidal Defence
TWUL	Thames Water Utilities Ltd.
UKCP	United Kingdom Climate Projections

1 INTRODUCTION

1.1 Objectives of the SFRA

The purpose of this Level 1 Strategic Flood Risk Assessment (SFRA) is to deliver the planning and flood risk requirements as defined by the 2019 National Planning Policy Framework (NPPF). This document will provide a strategic overview of all forms of flood risk throughout the London Borough of Richmond upon Thames, now and in the future. This document, and the associated web-based mapping delivered as part of the SFRA, will help to address local requirements, including the following:

- Climate change impacts, which will incorporate recently published guidance and will provide associated flood mapping for fluvial and tidal sources
- Specific policies and interpretations of the Flood Zones, including the incorporation of surface water flood risk into Flood Zone 3a
- Groundwater flooding issues, taking on board the recommendations from recent investigations

It is intended that this Level 1 SFRA will assist the London Borough of Richmond upon Thames in improving the strategic approach for managing flood risk across the borough. This approach will be balanced with the challenges posed to the borough through the need for increased development.

1.2 Document Structure – User Guidance

The document is broken down into eight sections, as described below:

- **Section 1 (Introduction)** provides an overview of the purpose and objectives of the SFRA.
- **Section 2 (Planning and Policy Framework)** provides an overview of the relevant national, regional and local policies relating to flood risk and associated requirements.
- **Section 3 (Data Sources and Mapping)** provides an overview of the web-based maps produced as part of the SFRA. The interactive maps depict the various flood risks across the study area. Further information on the SFRA web maps is found within the data sources list, which is provided as part of this document's appendices.
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- **Section 8 (Review and Next Steps)** provides a summary of the proposed update schedule for the SFRA (the technical content and the mapping) and information on Level 2 SFRA requirements.

1.3 A Living Document

This SFRA is intended to serve as a 'living document'. Its online maps utilise a range of different datasets, including flood risk data from the EA. This information is reviewed and updated on a regular basis.

The SFRA's PDF report is shaped by the latest legislation, policy and flood risk information. Any new Acts, policy directives, or information that may impact flood risk management and planning decisions will be reviewed in accordance with the information currently presented in the SFRA. Following completion of this version, any updates made to the SFRA report will be documented as required.

2 PLANNING AND POLICY FRAMEWORK

2.1 Overview

This section provides an overview of the policies, requirements and strategic documents that are relevant to flood risk in the London Borough of Richmond upon Thames. The national, regional and local level policy framework is outlined, all of which provide guidance for this SFRA.

Wherever possible, a hyperlink is provided for the referenced source material. Over time, the policies and documents referenced in this section may be superseded. It is advised that users of this document keep up to date with any changes to ensure that development proposals are in line with active policy.

2.2 National Policy

2.2.1 National Planning Policy Framework (2019)

The revised National Planning Policy Framework (NPPF) was published in February 2019 by the Ministry of Housing, Communities and Local Government (MHCLG), with a further update issued June 2019. It supersedes the previous NPPF which was published in March 2012 and revised in July 2018.

The document outlines the government's planning policies for England and how these are expected to be applied. The document provides a framework within which Local Planning Authorities (LPAs) can prepare plans for housing and other developments. It also provides guidance for prospective developers and applicants for planning application submissions. The NPPF revisions have been completed with the aim of improving and updating the plan-making process. Section 14 of the revised NPPF covers the need to meet '*The challenge of climate change, flooding and coastal change*'. Paragraphs 155-165 specifically relate to '*Planning and flood risk*'. Paragraph 156 highlights the importance of an SFRA and the role they should play in planning and flood risk:

"Strategic policies should be informed by a strategic flood risk assessment, and should manage flood risk from all sources. They should consider cumulative impacts in, or affecting, local areas susceptible to flooding, and take account of advice from the Environment Agency and other relevant flood risk management authorities, such as lead local flood authorities and internal drainage boards."

Paragraphs 157 to 164 of the NPPF outlines the Sequential and Exception Tests as a means of steering new development proposals to areas with the lowest risk of flooding. This SFRA provides the basis for applying these tests in the London Borough of Richmond upon Thames. Guidance for the application of the Sequential and Exception Tests can be found in *Section 7*.

The revised NPPF factors in the February 2017 White Paper on Fixing our broken housing market. The document introduces planning and housing market reforms, focusing on the idea of 'Planning for the right homes in the right places'. Some of the key changes linked to planning and flood risk include:

- Sustainable Drainage Systems (SuDS) in major developments (Paragraph 165) – Major developments should incorporate SuDS as part of their drainage scheme proposals unless proof can be provided that it would be inappropriate. The proposed SuDS should have appropriate minimum operational standards and provide multifunctional benefits where possible. Drainage proposals for major developments are assessed by Lead Local Flood Authorities (LLFAs) through their statutory consultee role as defined in Written Ministerial Statement HCWS161.
- Adjusting for climate change and flood risk impacts (Paragraph 157) – Local Plans should take into account the current and future impacts of climate change. If it is expected that climate

change may lead to an increase in flood risk, resulting in some existing development being less sustainable in the long term, opportunities should be sought to relocate the development.

- Cumulative flood risk impacts (Paragraph 156) – Strategic and planning policy on flood risk should consider cumulative flood risk impacts from all sources.

On 12 March 2020, MHCLG published 'Planning for the Future', a policy paper outlining government's ambitions for housing and planning following the announcement of the Budget on 11 March 2020. The 12 March publication was accompanied by a statement from the Housing Secretary, Robert Jenrick MP, outlining his 'plans for the future to get Britain building'. Within this, government has outlined its commitment to publishing a revised NPPF later in 2020. As part of government's 'green housing revolution', the NPPF will also include a review of the policy for building in areas at flood risk, seeking to ensure that communities across the country know that future development will be safe from floods. Government will assess whether current flood safeguarding protections in the NPPF are enough and consider options for further reform.

2.2.2 Flood Risk and Coastal Change Planning Practice Guidance (2014)

The 'Flood Risk and Coastal Change' section of the Planning Practice Guidance (PPG) was initially published in March 2014. As it is intended to serve as a living document, parts of the 'Flood Risk and Coastal Change' PPG have since been updated in line with the revised NPPF. It operates in conjunction with the NPPF, providing additional guidance and supporting information. This section of the PPG provides details on how LPAs and prospective developers and applicants can assess, avoid, manage and mitigate against flood risk.

The 'Flood Risk and Coastal Change' PPG defines flood risk and outlines Risk Management Authority (RMA) responsibilities for managing different sources of flooding. It provides guidance for LPAs on how to take flood risk into account in preparation of the Local Plan and detail on what should be included as part of an SFRA. As such, specific information from the PPG is referenced throughout this SFRA.

2.2.3 Flood and Water Management Act (2010)

The Flood and Water Management Act (FWMA) 2010 aims to provide an improved and effective method of managing flood risk across England and Wales. The FWMA was enacted following the Pitt Review of the 2007 floods. The Act implements recommendations from the review.

The FMWA defines the roles and responsibilities of RMAs in England and Wales, the bodies who manage flood risk from different flood sources. The Act defines the EA, LLFAs, District Councils (where there is no unitary authority), Internal Drainage Boards, Water & Sewerage Companies and Highway Authorities as RMAs. As an LLFA, Richmond upon Thames has several responsibilities under the FWMA:

- Developing, maintaining and applying a Local Flood Risk Management Strategy (LFRMS)
- Maintaining a flood risk asset register
- Managing the risk of flooding from local sources (surface water, groundwater and ordinary watercourses)
- Investigating and recording key local flood incidents
- Regulation of works on Ordinary Watercourses
- Sharing of information about flood risk

2.2.4 Flood Risk Regulations (2009)

The Flood Risk Regulations (FRR) 2009 translates the European Union's (EU) Floods Directive into law for England and Wales. The EU Floods Directive sets out a series of requirements to help make flood risk management more consistent across Europe.

The FRR sets out duties for LLFAs and the EA, requiring the RMAs to produce Preliminary Flood Risk Assessments (PFRAs), flood risk maps which show flooding extents and hazards, and Flood Risk Management Plans (FRMP). These requirements are completed on a six-year cycle and enable England and Wales to meet their legal obligations under the EU Floods Directive 2007.

The London Borough of Richmond upon Thames published their PFRA in May 2011. The document was reviewed in 2017 with no changes or additions to the assessment of risk following review. The majority of Richmond upon Thames is located within the London Flood Risk Area. Further information on the PFRA can be found in *Section 2.4.3*.

The EA published their FRMP for the Thames River Basin District in March 2016. The document covers a six-year cycle period spanning from 2015 to 2021. Further information on the FRMP can be found in *Section 2.3.5*.

2.2.5 National Flood and Coastal Erosion Risk Management Strategy

The National Flood and Coastal Erosion Risk Management (FCREM) Strategy was published in July 2020. The Strategy is updated from the Draft National FCERM Strategy following a public consultation in 2019. The strategy was adopted in September 2020. The previous National FCERM Strategy was published in 2011.

The National FCERM Strategy identifies climate change, and in turn the increased risk of flooding and coastal change, as a significant challenge. It outlines the Government's vision of "*a nation ready for, and resilient to, flooding and coastal change – today, tomorrow and to the year 2100*". It is a document that sets out the practical measures to be implemented by RMAs, partners and communities, which will contribute to longer term delivery objectives and the Government's vision. The next review for the finalised Strategy is planned for 2026. The EA plan to review and update the shorter term measures to ensure everything remains on track to support the Strategy's vision and longer term objectives.

Alongside the final Strategy, the EA is developing an action plan for the Strategy's measures, due to be published in April 2021. The action plan will contain information which the London Borough of Richmond upon Thames, other LLFAs, water and sewage companies, internal drainage boards, highway authorities and the EA will need to adhere to. From this, it is expected that Richmond upon Thames' Local Flood Risk Management Strategy and its Action Plan (see *Section 2.4.2*) will require an update.

2.3 Regional Planning Policy

2.3.1 London Plan 2021

The London Plan is the Greater London Authority's (GLA) statutory spatial development strategy plan for London. It has been prepared in accordance with the Greater London Authority Act 1999. It sets out a unified economic, environmental, transport and social framework for development in London over the next 20-25 years. The London Plan was first published in 2004 and has undergone various alterations, reviews and replacements since. The current London Plan was published in March 2021, superseding the previous one which was published in March 2016.

Chapter 9 of the document covers 'Sustainable Infrastructure' and features several policies relating to climate change, flood risk and water management, including 'Policy SI12 Flood risk management', 'Policy SI13 Sustainable drainage' and 'Policy SI17 Protecting London's waterways'. In addition, chapters covering 'Green Infrastructure and Natural Environment', 'Design', 'Spatial Development Patterns' and 'Planning London's Future – Good Growth' provide flood risk and water management guidance. A summary of the key policies from the current London Plan that are relevant to this SFRA can be seen below *[– Note that these policies have not been contested by the Secretary of State and therefore are highly unlikely to change in the final version]*:

- Policy SI 12 Flood risk management – The policy states that both current and expected flood risk from all sources across London should be managed in a sustainable and cost-effective way. This should be a collaborative effort between the EA, LLFAs, developers and infrastructure providers. It also sets out requirements for developments plans and development proposals.
- Policy SI 13 Sustainable drainage – The policy provides an updated drainage hierarchy (to that under the previous London Plan Policy 5.13) which development proposals need to adhere to when addressing surface water runoff. Proposals should aim to achieve greenfield runoff rates and manage surface water runoff as close to its source as possible, using the most sustainable solutions to reduce runoff volumes and rates. Development proposals should seek to include SuDS features to provide multiple benefits through their drainage scheme. In addition, LFRMS and SWMP documents produced by LLFAs should identify areas where there are particular surface water management issues and aim to reduce these risks.
- Policy SI 17 Protecting London's waterways – The policy requires that new developments support river and watercourse restoration. It addresses the protection of water spaces and their characteristics, with a particular priority for improving and restoring them.
- Policy GG6 Increasing efficiency and resilience – The policy states that buildings and infrastructure should be designed to adapt to climate change, utilise water efficiently and reduce flooding impacts.
- Policy SD2 Collaboration in the Wider South East – The policy states that collaboration with LPAs beyond London's boundaries on related challenges and opportunities is important. It highlights the need for collaborative working with the wider South East region of the country to tackle issues related to climate change, including water management and flood risk.
- Policy D11 Safety, security and resilience to emergency – The policy states that proposals should maximise building resilience and minimise potential physical risks that may arise from various hazards, including those that are flood risk related.
- Policy G1 Green Infrastructure – The policy states that LPAs should prepare green infrastructure strategies to ensure that green infrastructure is optimised and integrated within the built environment. The green infrastructure approach includes assets which provide natural or semi-natural drainage feature elements.
- Policy G5 Urban greening – The policy states that major development proposals should contribute to the greening of London by incorporating features such as high-quality landscaping and nature-based sustainable drainage. It also states that boroughs should develop an Urban Greening Factor to identify the amount of greening required in new urban developments.

2.3.2 London Regional Flood Risk Assessment 2018

The current London Regional Flood Risk Appraisal (RFRA), published in August 2014 by the GLA, is an accompaniment to the 2016 London Plan. The document provides a strategic overview of all sources

of flooding in London and addresses its probability and consequences. This includes the potential consequences of flooding as London's population continues to grow. The findings of the London RFRA support information presented in the 2016 London Plan, and provide details which shape the London Plan's policies. The London RFRA was first published in October 2009.

A new draft RFRA was made available in September 2018. The draft has not been published at the time of writing (March 2021), but plans suggest that it should be released imminently. The document builds on and updates the 2014 version of the RFRA. It represents important evidence to underpin the new draft London Plan. The document provides better information and evidence for Local Plans, Opportunity Area Planning Frameworks, and infrastructure providers through the RFRA's increased level of detail and the resultant mapping.

The new draft London RFRA provides a revised set of monitoring recommendations which have been further developed since the 2014 London RFRA. These monitoring recommendations were created as a monitoring tool to be used on a borough- or London-wide level. Each recommendation focuses upon a different flood risk source or potentially impacted site type, these being:

- Recommendation 1 – Tidal Flood Risk
- Recommendation 2 – Fluvial Flood Risk
- Recommendation 3 – Surface Water Flood Risk
- Recommendation 4 – Sewer Flood Risk
- Recommendation 5 – Groundwater Flood Risk
- Recommendation 6 – Reservoir Flood Risk
- Recommendation 7 – Flood Risk to Opportunity Areas and Town Centres
- Recommendation 8 – Flood Risk to Transport Infrastructure
- Recommendation 9 – Flood Risk to Emergency Services
- Recommendation 10 – Flood Risk to Schools
- Recommendation 11 – Flood Risk to Utility Infrastructure

These revised monitoring recommendations are intended to improve local risk policies and Drain London activities. It is suggested that these recommendations are incorporated into future Richmond upon Thames Local Plan policies and documents once finalised.

2.3.3 Thames Catchment Flood Management Plan 2009

The Thames Catchment Flood Management Plan (CFMP) was published in December 2009 by the EA. Its purpose is to provide an overview of the scale and extent of flooding now and in the future within the River Thames catchment area. The Thames CFMP also sets out the preferred plan and strategic policies to sustainably manage flood risks over the next 50 to 100 years with climate change in mind.

The London Borough of Richmond upon Thames lies within Sub-area 9, London Catchments, in the Thames CFMP (See *Figure 2-1*). It falls within the Beverley Brook and River Crane sub-areas as both EA designated main rivers are tributaries of the River Thames that flow through the borough. The preferred policy for Sub-area 9 is Policy 4 which states:

Policy 4: Areas of low, moderate or high flood risk where we are already managing the flood risk effectively but where we may need to take further actions to keep pace with climate change.

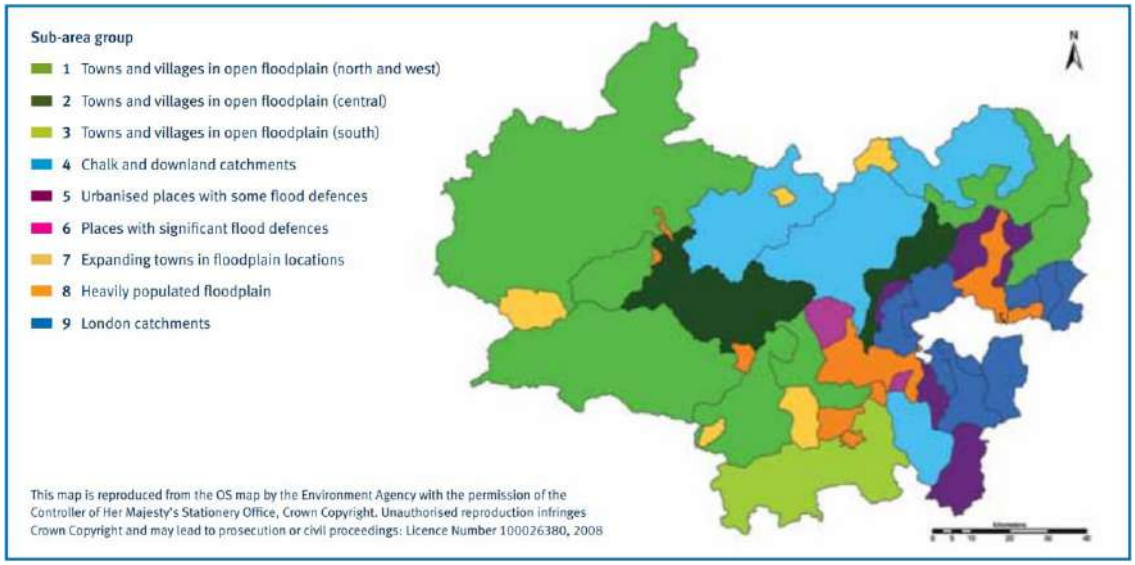


Figure 2-1. Thames CMFP Sub-Area Grouping (Thames CMFP Map)

The Thames CFMP identifies that the London Borough of Richmond upon Thames may have between 1,000-2,000 properties at risk from a 1% annual exceedance probability fluvial flood. It identifies that the most sustainable approach to managing future flood risk in the London Catchments area will be through adaptation of the urban environment. Through appropriate location, layout and design of redevelopment, there is an opportunity to make properties more resilient or resistant to flood water.

2.3.4 Thames Estuary 2100 Plan 2012

The Thames Estuary 2100 (TE2100) project was established in 2002 by the EA. It was created with the objective of developing a strategic flood risk management plan to reduce tidal flood risk through the 21st Century. The inclusion of other sources of flooding, including high river flows and surface water flooding implications on the estuary, resulted in the publishing of the TE2100 Plan in November 2012.

A TE2100 5 Year Monitoring Review document was published in October 2016, which provides a five-year review of the TE2100 Plan. Such reviews occur every five years by the EA. At the time of writing (March 2021), the EA are also undergoing the first ten year update of the TE2100 Plan which is made up of three phases:

- Phase 1: Monitoring Review (2019-2020)
- Phase 2: Economic Review (2020-2021)
- Phase 3: Plan Update (2020-2022)

Phase 2 will use new sea level rise information from the UK Climate Projections 2018 (UKCP18) and findings from Phase 1 to review the TE2100 Plan's policies. The TE2100 Plan, and associated documents, provide recommendations and actions for flood risk management for London and the Thames estuary through to the end of the century and beyond. It is suggested that the outcomes of Phase 3 are incorporated into future Richmond upon Thames Local Plan policies and documents.

The TE2100 establishes eight different regions that it classifies as action zones. These local action zones are also grouped together to form Action Zone 0. The places within each local Action Zone share similar characteristics and require a similar type and range of actions. The London Borough of Richmond upon Thames lies within Action Zone 1, 'West London'. The Plan introduces policy 'P3' and 'P5' for the London Borough of Richmond upon Thames to strategically manage flood risk from tidal and high river flow sources in the TE2100 Plan area. Policy P3 covers the areas of Richmond and Twickenham, and P5 for Barnes & Kew. The policies state:

- P3: Continue with existing or alternative actions to manage flood risk. We will continue to maintain flood defences at their current level accepting that the likelihood and/or consequences of a flood will increase because of climate change.
- P5: Take further action to reduce the risk of flooding (now or in the future).

The document provides recommendations for the London Borough of Richmond upon Thames and other implementation partners. This includes agreeing a programme for planning, and putting in place within 25 years, alternative measures for managing fluvial flood risk in the west London tidal area.

2.3.5 Thames River Basin Flood Risk Management Plan 2016

The Thames River Basin Flood Risk Management Plan (FRMP) was published in March 2016. The Thames River Basin FRMP is produced in line with the EU Floods Directive (2007), helping to meet the Directive's requirements for RMAs to produce FRMPs. In the UK the Directive's requirements are legislated through the FRR 2009. The documents are updated on a six-yearly basis. They set out how RMAs will work with communities to manage flood and coastal risk over the next six years within the Thames River Basin District. The current cycle runs from 2015 to 2021.

The objectives of the Thames River Basin FRMP are grouped into social, economic, and environmental themes. They outline the main areas where RMAs aim to make improvements. A set of Thames River Basin District-wide measures have been produced to work towards achieving specific objectives. These measures fall under one of four different categories:

- Preventing risk
- Protecting from risk
- Preparing for risk
- Recovery and review

Details on these objectives and measure categories can be viewed in Sections 4 and 8 of Part A of the Thames River Basin FRMP. A new Thames River Basin FRMP is currently under production, expected to be published by December 2021. The London Borough of Richmond upon Thames will be involved in this process through the review of existing, and the creation of new, FRMP objectives and measures.

2.3.6 River Thames Scheme: Reducing flood risk from Datchet to Teddington

The River Thames Scheme is a flood risk management strategy that intends to reduce flood risk to communities along the Thames between Datchet and Teddington. The region has a history of serious flooding, with major events taking place in 1947, 1968, 2003, and 2014. The EA produced a Lower Thames Flood Risk Management Strategy in August 2010 which recommended that the Strategy is approved "*in order to manage the risks of fluvial flooding to over 20,000 properties*".

The Scheme will introduce a new flood channel alongside the River Thames, upstream of Richmond upon Thames, to reduce flood risk. There will be improvements to defences and existing assets, including the Teddington weir. It will deliver many benefits, including:

- better protection from flooding for 15,000 homes and 2,400 businesses
- more resilient road, rail, power and water networks
- 106 hectares of new public open space
- improved biodiversity for wildlife through the creation of 250 hectares of new habitat

At the time of writing (March 2021) the EA's project team is working with partners to secure the necessary approval required to construct the River Thames Scheme. The Scheme's planning application will provide opportunities for communities to discuss the proposals.

2.3.7 Thames Landscape Strategy

The Thames Landscape Strategy was a report written by Kim Wilkie and originally published in 1994. The report analysed various different aspects of the river corridor to help shape future policy, management, projects and design. The area covered in the Thames Landscape Strategy runs from Hampton to Kew. The Strategy covers a number of areas that fall within the Borough including Bushy Park, Hampton Court, Hampton Wick, Teddington, Twickenham, Ham, Richmond and Kew.

A review of the 1994 strategic report was undertaken and published in 2012. The new document takes more recent priorities into account such as those outlined in the climate change and new policy frameworks, including the London Plan. The document provides objectives to work towards the overarching aim of understanding the river landscape and to respecting its character - both natural and man-made aspects. It also provides recommendations for implementation, including those linked to 'habitat creation and floodplain restoration' and 'land management'.

A Thames Landscape Strategy Action Plan for 2017 to 2020 has been published. It sets out a programme of works up to 2020 in line with the Strategy.

2.3.8 Thames Strategy

The 'Thames Strategy – Kew to Chelsea' seeks to promote the River Thames and to encourage appropriate development along its banks as it becomes an increasingly ecologically diverse, clean and more socially accessible environment. Launched in 2002, the Thames Strategy – Kew to Chelsea has developed a one hundred year blueprint that seeks to ensure that all future development along this stretch of the Thames places the conservation and enhancement of the "natural", built and social environment at the heart of all decisions made.

A primary objective of the Strategy has been to identify and action heritage and environmental projects. It also aims to contribute towards management plans along the River Thames in the Kew to Chelsea sub-region. The Strategy has applied a holistic approach to dealing with the diverse and complex demands of different river users on this delicate resource.

2.3.9 London Sustainable Drainage Action Plan

The London Sustainable Drainage Action Plan (LSDAP) was published in 2016. The Plan aims to address the flood risk challenges posed by London's increasing population, changing land use, and climate change which places pressure on the city's drainage and sewer system.

Increased surface water runoff and greater foul water discharges have frequently left the existing drainage systems across London over utilised. In response, the GLA have produced the LSDAP to help reduce the increasing flood risk. The main focus of the Plan is retrofitting sustainable drainage to existing infrastructure, buildings, and land. It looks at opportunities where retrofitting schemes can be implemented at lower costs, and also provides money saving measures to local users.

The LSDAP aims to set the direction for the next 20 years. It provides short-term objectives, setting out 40 actions specifically for 2016 to 2021. These actions require the GLA to work in partnership with RMAs including the EA, Thames Water Utilities Ltd. (TWUL), Transport for London and London Boroughs. The actions range from wider policy improvements and delivery of SuDS projects, to the identification of opportunities to better implement SuDS in schools, housing and transport schemes.

2.4 Local Planning Policy

2.4.1 Local Plan

The Richmond upon Thames Local Plan was adopted in July 2018. It sets out policies and guidance for the development of the borough over the following 15 years, looking ahead to 2033.

The document has a set of strategic visions and objectives that fall under one of the following themes: 'Protecting Local Character', 'A Sustainable Future' or 'Meeting People's Needs'. As per the revised NPPF 2019, Local Plans should take into account the current and future impacts of climate change (see *Section 2.2.2* for further details on NPPF requirements). In recognition of this, Richmond upon Thames' Local Plan has two strategic objectives under 'A Sustainable Future' regarding climate change. One objective requires high levels of sustainable design and construction to minimise and mitigate against the effects of climate change with regards to carbon dioxide emissions, energy consumption and water efficiency. The other promotes and encourages developments to be fully resilient to future impacts of climate change, minimising the risk of flooding, water shortages, subsidence and overheating.

Policy LP 21 of the Local Plan is about Flood Risk and Sustainable Drainage. It states that:

"All developments should avoid, or minimise, contributing to all sources of flooding, including fluvial, tidal, surface water, groundwater and flooding from sewers, taking account of climate change and without increasing flood risk elsewhere. Unacceptable developments and land uses will be refused in line with national policy and guidance [and] the Council's Strategic Flood Risk Assessment (SFRA)".

The policy requires developments to be guided to areas with the lowest risk in line with the revised NPPF. It includes Flood Risk Assessment (FRA) guidance for developers and applicants and outlines requirements for the following areas:

- Basements and subterranean developments
- Flood defences
- Sustainable drainage

It provides details on the Sequential and Exception Tests, functional floodplain, and flood emergency plans. For further information on flood risk and sustainable drainage guidance, see *Section 6.1*.

2.4.2 Local Flood Risk Management Strategy

The London Borough of Richmond upon Thames Local Flood Risk Management Strategy (LFRMS) and Action Plan was published in August 2015. The LFRMS was produced in line with the requirements of the FWMA 2010 and National FCERM Strategy. The document's overarching objective is to better understand, communicate and manage flood risk in the London Borough of Richmond upon Thames through partnership working. It aims to do this through sustainable and coordinated approaches for the benefit of all receptors, including property, people, and the environment. The LFRMS sets out the London Borough of Richmond upon Thames' approach to limiting the impacts of localised flood risk across the borough. It is a high-level document which sets out five objectives with a set of associated measures for flood risk management. Those objectives are:

- Encourage direct involvement in decision making through the establishment of and maintaining partnerships with key organisations, including the Environment Agency and Thames Water.
- Improve our knowledge and understanding of the interactions between different sources of flooding in the Borough.
- Encourage residents, businesses and local landowners to take action and contribute to the management and reduction of flood risk.
- Target resources where they have the greatest effect by adopting a risk-based approach.

- Contribute to wider social, economic and environmental outcomes by encouraging sustainable multi-benefit solutions for the management of local flood risk.

These objectives and their accompanying flood risk management measures and actions have been assessed against the London Borough of Richmond upon Thames' Strategic Environment Assessment (SEA) objectives. The SEA demonstrates that the LFRMS should have a positive impact on local flood risk and the environment in both the short and long term.

Upon the publication of the 2020 National FCERM Strategy (see *Section 2.2.5*), it is expected that the London Borough of Richmond upon Thames will update their LFRMS to align with the themes and objectives of the National FCERM.

2.4.3 Preliminary Flood Risk Assessment

The original Preliminary Flood Risk Assessment (PFRA) was published in 2011. It was produced in line with the EU Floods Directive 2007 and FRR 2009 requirements, which aims to make flood risk management more consistent across Europe (see *Section 2.2.4* for further information). All original PFRAs for London boroughs were written as part of the Drain London project to ensure consistency.

The PFRA is a stock take of flood risk in the London Borough of Richmond upon Thames designed to help inform the strategic management of flood risk in the borough. The Assessment analyses previous significant flood incidents and identifies key flood risk areas. It also analyses future flood risk through undertaking a high-level assessment of the available data flood risk data. This includes information from the EA, TWUL, the London Fire Brigade, and information held by the London Borough of Richmond upon Thames. As part of this PFRA, the London Borough of Richmond upon Thames confirmed that the Indicative Flood Risk Area (delineated by the EA in 2010), which covered the majority of the borough, did not need altering.

2.4.4 Surface Water Management Plan

The Surface Water Management Plan (SWMP) was published in June 2011. The document helps LLFAs meet certain requirements as outlined in the FRR 2009, as it can provide the evidence based to inform PFRAs and help fulfil the requirement for FRMPs. The London Borough of Richmond upon Thames SWMP was created as part of the Drain London project to outline the preferred management strategy for surface water runoff for each borough.

The SWMP describes predicted and historic flooding from various sources which may impact upon surface water flood risk, including sewers, drains, groundwater plus runoff from land, small watercourses and ditches. It is broken down into a four-phase approach: Phase 1 – Preparation; Phase 2 – Risk Assessment; Phase 3 – Options; and Phase 4 – Implementation and Review.

As part of the Risk Assessment phase, the SWMP defined Critical Drainage Areas (CDAs) for the London Borough of Richmond upon Thames. CDAs are geographical areas (usually hydrological catchments) where multiple and cumulative sources of flood risk have the potential of causing flooding in one or more Local Flood Risk Zones. The impact of this potential flooding could affect people, property, and local infrastructure. The SWMP identified seven CDAs in the Borough:

- CDA 001: Twickenham
- CDA 002: St Margarets
- CDA 003: Strawberry Hill
- CDA 004: Richmond and Mortlake
- CDA 005: Petersham
- CDA 006: Teddington
- CDA 007: Hampton Wick

As part of the Options phase, the SWMP recommends potential mitigation options that could be incorporated into future CDA flood alleviation schemes. Full details regarding these options can be viewed in Section 4.3 of the SWMP.

2.4.5 Climate Change Declaration (Climate Emergency)

In July 2019, the London Borough of Richmond upon Thames unanimously passed a pair of complementary motions relating to climate change. In doing so, the London Borough of Richmond upon Thames has joined a growing number of other Local Authorities who have declared a 'Climate Change Emergency' whilst endorsing Parliament's declaration of a national climate change emergency.

Following the declaration of a 'Climate Change Emergency', the London Borough of Richmond upon Thames published the Climate Emergency Strategy 2019-2024 in January 2020. The Strategy sets out what the London Borough of Richmond upon Thames plans to do to reduce the impact of climate change and mitigate its effects. It also outlines measures for residents to further help with this overarching objective.

The Strategy has a Water Management and Flood Abatement section which outlines the London Borough of Richmond upon Thames' ambition to address flood risk and promote sustainable drainage. It highlights the objective to promote and encourage development to be fully resilient to the future impacts of climate change in order to minimise vulnerability of people and property. By 2024, the London Borough of Richmond upon Thames aims to:

- Be fully aware of the flooding threats to the borough arising from climate change and have planning policies and solutions in place that take full account of this, including new Sustainable Drainage Systems that minimise the chance of flooding.
- Have drinking fountains across the borough, so residents have access to clean fresh water at all times.
- Have decreased the potential for flash flooding in the borough by working with residents, communities and businesses to capture rainfall through the creation of blue and green roofs and rain gardens.

The London Borough of Richmond upon Thames has created a full list of associated actions to help meet their objectives. These actions are listed in Appendix A of the Climate Emergency Strategy 2019-2024 suite of documents. The actions and targets most relevant to flood risk management which are linked to planning and development include:

- Action 62: Green roofs and/or brown roofs should be incorporated into new major developments with a roof plate area of 100 square metres, where it is technically feasible and visually acceptable in accordance with Local Plan policy LP17.
- Action 169: Use our Local Plan to apply planning solutions to flood risk management wherever possible by steering vulnerable development away from areas affected by flooding in accordance with the NPPF Sequential Test.
- Action 170: Promote green infrastructure to act as flood storage areas, holding large volumes of water in temporary ponds to protect built up areas from flooding.
- Action 171: Update the Strategic Flood Risk Assessment so we have up to date evidence on flood risk for the borough *[– Note that this will be achieved through the publication of this new SFRA]*.
- Action 176: Identify opportunities for reducing runoff and improving storage capacity and highlight to businesses and residents.

3 DATA SOURCES AND MAPPING

3.1 Online mapping

The London Borough of Richmond upon Thames SFRA maps are delivered in a web format, providing information on the different sources of flooding which impact the borough. The web map format enables users to select the information they would like to view at a range of different scales. The SFRA provides the following four maps:

- Fluvial & Tidal Flood Risk
- Surface Water Flood Risk
- Groundwater, Sewer and Artificial Flood Risk
- Policy

The Appendix section provides information on the data used for the web maps, including details about data origin and any key limitations.

4 Applying Climate Change to Risk Assessment

4.1 Overview

The EA published the Adapting to a Changing Climate report in May 2016. The document serves as the second adaptation report under the Climate Change Act 2008. It highlights that records demonstrate severe changing weather, with warmer temperatures, heavier rainfall and higher risk of drought. The report references the UK Climate Projections 2009 (UKCP09) which demonstrated the potential future impacts that a changing climate poses. UKCP18 was then released, providing a new set of climate projections for the UK. The projections from UKCP18 are broadly consistent with the UKCP09 projections, however, there are some seasonal and location differences for rainfall and temperature. These projections indicate that severe flooding may happen more often.

In response to growing evidence and climate change projections, Parliament declared a national climate change emergency on 1 May 2019. In July 2019, the London Borough of Richmond upon Thames declared a 'Climate Change Emergency' whilst endorsing Parliament's declaration (see *Section 2.4.5* for details).

The 2019 revised NPPF sets out a number of considerations for planning for climate change. It states that:

"Plans should take a proactive approach to mitigating and adapting to climate change, taking into account the long-term implications for flood risk, coastal change, water supply, biodiversity and landscapes, and the risk of overheating from rising temperatures."

Policies should support measures to increase community and infrastructure resilience against climate change. Tt is vital that all risk assessments appropriately assess the impacts of climate change.

4.2 Climate Change Guidance

4.2.1 Updates

The EA updated their Flood Risk Assessments: Climate Change Allowances guidance in 2016. This updated guidance provides information on how climate change allowances should be applied for SFRAs and site-specific FRAs. The climate change allowances are based on UK climate change projections and are predictions of anticipated change for:

- Peak river flow
- Peak rainfall intensity
- Sea level rise
- Offshore wind speed and extreme wave height

Since 2019, the EA have been revising their Climate Change Allowances to incorporate UKCP18 data. This is still ongoing at the time of writing, with the most recent amendments being made in July 2020 for peak river flow, sea level rise, wind speed, wave height and storm surge. UKCP18 impacts on peak rainfall intensity are currently being assessed by the EA and future Climate Change Allowance revisions are expected in the future. It is suggested that the outcomes of these peak rainfall revisions are also incorporated into future Richmond upon Thames Local Plan policies and documents once finalised.

UKCP18 builds on the success of the UKCP09, providing an upgrade to the range of climate projection tools available for use. Updates include:

- Up-to-date assessments of how the climate of the UK may change over the 21st century.
- High-resolution spatially coherent future climate projections for the globe at 60km scale and for the UK at 12km scale.
- Downscaling the 12km climate model to a 2.2km scale.
- Marine projections of sea-level rise and storm surge.

The TE2100 Plan is designed to be adaptable to different projections for climate change and sea level rise. The Plan is reviewed every five years and is fully reviewed and updated every ten years. The current iteration of the Plan was published in 2012 and reviewed in 2016. It uses the latest climate change guidance that was available when the Plan was developed in 2009. As part of the next review and update, which is being carried out at the time of writing (March 2021) and is due to be completed in 2022, the Plan will use UKCP18 to update predictions of future extreme sea level scenarios. This includes the assessment of the potential climate change impact on the future defence levels and maximum likely water levels. Changes will not be made to the required crest levels, however, it is possible that dates for required raisings will need to be brought forward or pushed back.

Prospective developers and applicants should check the UKCP guidance to ensure the latest information is used as part of any FRAs. The UK Climate Projections: Headline Findings were published in September 2019 and provides details on the key conclusions from UKCP18. Assessments of tidal flood risk should continue to use the current TE2100 crest levels guidance and breach modelling.

4.2.2 Applying the updated climate change guidance

To correctly apply the latest climate change guidance, it is vital that developers and prospective applicants know the following information:

- Assessments of tidal flood risk should use the current TE2100 crest levels guidance and breach modelling – not the latest UKCP18.
- The likely lifetime of the proposed development – This typically is 100 years for residential developments and 60 years for commercial developments. However, developers and prospective applicants should highlight this in the FRA, where they are expected to justify why they have adopted a given lifetime for the proposed development.
- The vulnerability classification of the proposed development – See Table 2 of the 'Flood Risk and Coastal Change' PPG.
- The epoch period for peak rainfall intensity – See Table 2 of the 'Flood risk assessments: climate change allowances'. It is likely that the development, due to their likely lifetime, is going to fall under the 2080 epoch. Allowances are split into 'upper end' and 'central'. The issued guidance states that FRAs should assess both the 'central' and 'upper end' allowances to understand the range of impact.
- The River Basin District that the proposed development falls in – the London Borough of Richmond upon Thames is within the Thames River Basin District. All FRAs that require peak river flow allowances should use the 'Thames' allowance percentages as seen in Table 1 of the Flood risk assessments: climate change allowances'. Allowances are split into 'high++', 'upper end', 'higher central' and 'central'. The issued guidance provides information on how to decide which peak river flow allowance should be used for FRAs. At the time of writing (March 2021) guidance on how the 'H++' category should be applied to development management decisions has not been released. Developers and applicants need to consider the flood risk vulnerability classification of their proposed development and the flood zone that it falls within.
- The capacity within the development to include required and additional resilience measures to further protect the proposed development against impacts of climate change.

4.3 Adapting to Climate Change

The PPG has a section on Climate Change. It highlights that addressing climate change is one of the core land use planning principles which the NPPF expects to underpin both plan-making and decision-taking.

It provides guidance on determining and implementing suitable measures in the planning process to address the potential risks of climate change. To adapt to climate change, the PPG suggests:

- Considering future climate risks when allocating development sites to ensure risks are understood over the development's lifetime.
- Considering the impact of and promoting design responses to flood risk and coastal change for the lifetime of the development.
- Considering availability of water and water infrastructure for the lifetime of the development and design responses to promote water efficiency and protect water quality.
- Promoting adaptation approaches in design policies for developments and the public realm.

5 Assessment of Flood Risk

5.1 Responsibilities

As part of their FWMA 2010 responsibilities (see *Section 2.2.3*), RMAs must contribute towards the achievement of sustainable development and collaborate on matters relating to flood risk management. All RMAs have a duty to co-operate and share information and act in a way that is consistent with National FCERM Strategy. This may be through preparing relevant flood risk documents, assisting with development planning, or providing consent for flood risk related activities. *Table 5-1* provides a list of RMAs and their responsibilities for flood risk management.

Table 5-1. Risk Management Authorities and Responsibilities

Risk Management Authority	Responsibility (within the context of this SFRA)
Department for Environment, Food & Rural Affairs (DEFRA)	Overall national responsibility for policy on FCERM in England. DEFRA also provides funding for flood risk management.
Environment Agency (EA)	Supervises and works with others to manage flood risk and coastal erosion. They manage flood risk from main rivers, the sea and reservoirs. They have a range of responsibilities: • Providing flood risk advice to LPAs regarding development proposals in Flood Zones 2 and 3. • Managing fluvial and coastal flood risk by carrying out works. • Issuing and operating flood warning systems. • Facilitating works on or near main rivers, and works affecting watercourses, flood and sea defences and other structures protected by its byelaw by issuing consent. • Providing advice on development proposals (see *Section 6* for further details).
Lead Local Flood Authorities (LLFAs)	All London Boroughs are Unitary Authorities and deliver the LLFA role for their respective administrative areas. LLFAs have the lead operational role in managing flood risk from surface water, ordinary watercourses and groundwater sources. Their responsibilities include: • Developing, applying, maintaining and monitoring strategies for local flood risk management, including being involved in the preparation of SFRAs. • Preparing and maintaining a preliminary flood risk assessment, flood hazard maps, flood risk maps and flood risk management plans. • Designating structures and features that may have an effect on local flood or coastal erosion risk. • Investigating and reporting flood incidents (that reach a certain threshold). • Creating policies and guidelines to ensure that flood risk management work is effective. • Providing advice on major development proposals with surface water drainage implications (see *Section 6* for further details). • Regulation and enforcement of works on ordinary watercourses.
Highway Authorities	Within London this includes Highways England, all London Boroughs and Transport for London who are responsible for providing and managing highway drainage. There is no Highways England network within Richmond upon Thames. When necessary, they must work with the EA and LLFAs when: • Working on highway drainage. • Working in roadside ditches. • Carrying out works on part of a watercourse. • Managing highway flooding.
Water and Sewerage Companies	Primary responsibility for floods from water & sewerage systems (sewer flooding, burst pipes or water mains, floods caused by system failures). Thames Water Utilities Ltd (TWUL). is the relevant water and sewerage company in the borough and have powers under the Water Industry Act 1991 regarding connection of proposed developments to their networks.

5.2 Fluvial Flood Risk

Fluvial flooding, also known as main river flooding, occurs when heavy or prolonged periods of rain causes a river to exceed its capacity. Excessive snow melt can cause fluvial flooding, as can high tides and storm surges for rivers with tidal influences. Floodplains and adjacent open spaces in the natural environment help manage and convey overbank flooding, mitigating the potential widespread impact of fluvial flooding. Urbanisation can exacerbate the effects of fluvial flooding due to increased impermeable surfaces and development within the potential flood plain. The increase in runoff rates results in greater volumes of water entering rivers and an increase in water flows. The impact of fluvial flooding on urban environments can be severe, causing significant social, economic and environmental impacts.

The risk of flooding from fluvial sources is shown in the Fluvial & Tidal Flood Risk Web Map. This breaks down the probability of fluvial flooding across Richmond upon Thames based on the EA's Flood Zone categories. These Flood Zones are split into categories 1 – 3, with Flood Zone 1 having the lowest risk of fluvial flooding and Flood Zone 3 having the highest risk of fluvial flooding. Flood Zone 3 is further broken down into Flood Zone 3a (high probability) and Flood Zone 3b (the functional floodplain), these being defined by LPAs in their SFRA. The EA's Flood Zones are based on the undefended flood scenario and does not account for the 'actual' flood risk in an area that benefits from flood defence assets. *Section 5.5* of this document provides further information on Flood Zone 3b and functional floodplains and the London Borough of Richmond upon Thames' definition of each. The definition of each Flood Zone can be found in the Flood Zone table in the 'Flood Risk and Coastal Change' section of the PPG.

The River Thames is an EA designated main river that flows through the middle of the borough. In the London Borough of Richmond upon Thames it is both a tidal and non-tidal river, the tidal section having affected parts of the borough numerous times through flooding. For further information on the River Thames' tidal flood risks, see *Section 5.3*. The non-tidal section is upstream of Teddington Lock.

The River Crane and the Beverley Brook are EA designated main rivers that also flow through the borough. Both rivers are tributaries of the River Thames, with the River Crane situated to the north of the Thames (in the west of the borough), and the Beverley Brook situated to the south of the Thames (in the east of the borough). They both pose a fluvial flood risk to properties in their hydrological catchment. Compared to the River Thames, they are flashier systems that have a faster response to heavy or prolonged periods of rainfall. For further information on the flood risk posed by the River Crane and the Beverley Brook, see the Fluvial & Tidal Flood Risk Web Map.

The Fluvial & Tidal Flood Risk Web Map highlights areas at risk of fluvial flooding that currently benefit from flood defences. Structural failure of defences presents a residual risk due to breaching or overtopping onto defended areas. The map also highlights the areas benefitting from flood defences on the 'EA Flood Map for Planning (River and Sea) – Areas Benefitting from Flood Defence' operational layer. FRAs for development proposals should consider both 'actual' and 'residual' flood risks if a proposed site is protected by flood defences. *Section 6.1* defines development proposal requirements.

5.2.1 Impacts of climate change

Based on the EA's UK climate change projections for peak river flow and peak rainfall intensity, it is expected that climate change will place a greater number of people, properties and infrastructure at risk of fluvial flooding. The frequency and severity of fluvial flooding would increase, increasing the need for flood defence and mitigation measures for the River Thames, River Crane and Beverley Brook.

5.3 Tidal Flood Risk

The River Thames is a partially tidal and partially non-tidal river in the London Borough of Richmond upon Thames, the upstream extent of the tidal section being at Teddington Lock. Tidal flooding occurs during extreme high tide and / or storm surge events. The River Thames provides the greatest flood risk in the borough when storm surges coincide with extremely high tide levels. The risk to the borough is also increased as the London Borough of Richmond upon Thames is the only London borough which the River Thames dissects. This means there are properties both on the north and south side of the River Thames at risk. The risk of tidal flooding is shown in the Fluvial & Tidal Flood Risk Web Map.

The Thames Tidal Defences (TTD) are a collection of walls, embankments, flood gates, pumping stations and barriers designed to protect at-risk properties against flooding from the River Thames. Of these assets, the Thames Barrier is the most significant structure that offers protection against tidal flooding. The barrier provides protection against extremely high tides and storm surges moving from the North Sea up through the Thames Estuary. These flood defences currently protect properties within the floodplain up to a 1 in 1000 year event. The Fluvial & Tidal Map highlights the areas benefitting from flood defences through the 'EA Flood Map for Planning (River and Sea) – Areas Benefitting from Flood Defence' operational layer. This information is also present in the Fluvial & Tidal Flood Risk Web Map.

The TE2100 Plan highlights that with some modifications, the Thames Barrier will continue to provide flood protection up until 2070. The document provides information and recommendations to ensure that the same level of protection currently offered will be provided up until the year 2100. Further information is provided in *Section 2.3.4*.

The Fluvial & Tidal Flood Risk Web Map highlights areas at risk of tidal flooding modelled to the year 2100. The map contains maximum extent, hazard, elevation and depth of flooding data if an individual breach were to occur at any point on the TTD. Areas that currently benefit from the TTD are included in the layer 'Areas Benefitting from Flood Defences'. The 'actual' flood risk for properties in Thames tidal floodplain is reduced as a result. FRAs for development proposals should consider 'actual' and 'residual' flood risks if the proposed site is protected by the TTD scheme. For further guidance, see *Section 2.3.4* for information on policies and recommendations provided by the TE2100 plan and *Section 6.1* for development proposal requirements. For further information on the residual risk of flooding in the London Borough of Richmond upon Thames, see *Section 5.9*.

5.3.1 Impacts of climate change

Based on the EA's UK climate change projections for peak river flow and sea level rise, it is expected that climate change will place a greater number of people, properties and infrastructure at risk of tidal flooding. The tidal influences on the River Thames mean that the water levels within this stretch of the river is governed by sea levels and tidal surges influenced by the North Sea. As a result, climate change will influence rising sea levels and the water levels within the river. The EA expect the Thames Barrier to continue to protect London to its current standard up until 2070. However, in addition to managing tidal flood risk, the Barrier is also used to help reduce flooding after heavy or prolonged rainfall in West London. Closing the Barrier to shut out the incoming high tide increases the upstream capacity in the Thames and some of its tributaries, reducing the risk of them overtopping.

If the Barrier continues to be used in this way, the annual number of closures will increase and there will be less time available for essential maintenance. In order to preserve the life and function of the Barrier, the EA need to put a strategy in place by 2035 to manage other types of flooding without relying on the Barrier. The EA are therefore developing flood models to help improve the

understanding of the complex interaction of the tidal and non-tidal effects (e.g. river flows and rainfall) of flooding in West London. This will enable the EA, their partners, and the communities affected to work together to consider alternative options for managing other types of flooding in West London.

5.4 Surface Water and Ordinary Watercourse Flood Risk

Surface water flooding occurs as a result of high intensity rainfall where water ponds or flows over ground before entering the underground drainage network or a watercourse. Ordinary watercourse flooding occurs under similar circumstances but is associated with non-main river watercourses or ditches. Surface water flooding is often exacerbated by the intensity or duration of the rainfall event overwhelming drainage points, leaving soil, drainage channels and other drainage systems incapable of draining water away at a sufficient rate. Extreme weather conditions can also lead to ordinary watercourses exceeding their capacity, overwhelming systems and causing water to flow onto land.

For the purposes of this SFRA, the risk of flooding from ordinary watercourses is covered within the 'surface water' terminology. This aligns with the inclusion of ordinary watercourse flood risks within the EA's Risk of Flooding from Surface Water (RoFSW) mapping.

Surface water flooding varies throughout the London Borough of Richmond upon Thames. The borough has several large areas of green space. These areas help mitigate against the impact of surface water runoff due to vegetation and soil percolation reducing peak runoff. However, the borough also has heavily urbanised and densely populated areas. The majority of the ground coverage in these areas is impermeable, increasing overland flows as less water is able to drain away through infiltration. These flow paths will flow towards topographical low points and have a higher peak runoff rate. This places people and buildings along these overland flow paths at risk of surface water flooding.

The Surface Water Flood Risk Web Map highlights areas identified as at risk of surface water flooding. The mapping consists of the flood extent and depth of rainfall scenarios with a 3.3% (1 in 30), 1% (1 in 100) and 0.1% (1 in 1000) chance of occurring in any given year. Please note that the RoFSW map layers are national dataset layers that are optimised for viewing at 1:10,000 scale. They are not optimised for identifying surface water flood risk at a property level scale. The map also provides information on reported flooding incidents as received by TWUL. Information on surface water flood risk requirements and guidance for FRAs can be found in *Section 6.3.2*.

5.4.1 Impacts of climate change

Based on the EA's UK climate change projections for peak rainfall intensity, it is expected that climate change will place a greater number of people, properties and infrastructure at risk of surface water flooding. The EA's Adapting to a Changing Climate report (2016) highlights that wetter winters and more intense rainfall will cause more surface water runoff, leading to more localised flooding. The increase in surface water runoff will put sewers and the drainage network under greater pressure, increasing the likelihood of sewer-related flooding. See *Section 5.7* for information on sewer flooding.

5.5 Flood Zone 3

The EA have created Flood Zones to demonstrate the probability of somewhere flooding due to fluvial or tidal flooding. In addition to providing indicative flood risk information, the Flood Zones are a tool used in the planning process with the Sequential and Exception Tests (see *Section 6.1* for details). The Flood Zones are defined in the PPG, 'Flood Risk and Coastal Change', Table 1. Flood Zones 1 and 2 are defined as:

- Flood Zone 1 - Land that has a 'Low Probability' of fluvial or tidal flooding. There is a less than 1 in 1,000 (< 0.1%) annual probability of river or sea flooding.

- Flood Zone 2 – Land that has a 'Medium Probability' of fluvial or tidal flooding. There is a 1 in 100 to 1 in 1,000 (1% to 0.1%) annual probability of river flooding, or a 1 in 200 to 1 in 1,000 (0.5% to 0.1%) annual probability of sea flooding.

Flood Zone 3 is comprised of Flood Zone 3a and Flood Zone 3b for fluvial and tidal flooding. Further information on the two components of Flood Zone 3 is detailed below.

5.5.1 Flood Zone 3b (tidal and fluvial)

Paragraph 015 of the 'Flood Risk and Coastal Change' section of the PPG states that the functional floodplain is usually defined, as a minimum, as land which would naturally flood up to and including a 1 in 20 year return period event or designed to flood in an extreme (1 in 1,000 year) event.

The PPG states that the extent of the functional floodplain, also known as Flood Zone 3b, should be defined by LPAs within their SFRAs. This allows for the incorporation of local circumstances and must be agreed with the EA and the boroughs' LLFAs. As such, this SFRA defines Flood Zone 3b (functional floodplain – fluvial/tidal) as the following:

"*Land within EA modelled fluvial and tidal flood risk extents predicted for up to and including 1 in 20 year return period events, allowing for the impact of flood defences. It also includes land featured as part of the EA's Flood Storage Areas dataset.*"

The islands within the River Thames (see *Section 6.2.4* for a list of islands) are entirely within Flood Zone 2, and a large proportion of their total area coverage is within Flood Zone 3a and their access and egress routes in Flood Zone 3b. For further information on flood risk and development guidance on the islands with established communities, please see *Section 6.2*.

5.5.2 Flood Zone 3a (tidal and fluvial)

The PPG defines Flood Zone 3a as land that has a 'High Probability' of fluvial or tidal flooding. There is a greater than 1 in 100 (> 1%) annual probability of river flooding, or a greater than 1 in 200 (> 0.5%) annual probability of sea flooding.

In accordance with the PPG, this SFRA defines Flood Zone 3a (tidal and fluvial) as the following:

"*Land within EA modelled fluvial flood risk extents predicted for up to and including 1 in 100 year return period events. It also includes land within EA modelled tidal flood risk extents predicted for up to and including 1 in 200 year return period events.*"

5.5.3 Article 4 Direction on Basement Developments

An Article 4 Direction is in place to manage basement development in areas potentially at risk of fluvial or tidal flooding. The purpose of the Direction is to monitor and, if necessary, restrict the development of basements in areas where basement development may increase the risk to life due to flooding. This would remove the permitted development rights granted by Schedule 2 (Article 3) of the Town and Country Planning (Development Management Procedure) (England) Order 2015 in the area specified in the Direction. The Direction would apply to all types of basement developments including extensions, conversion and change of use to a higher 'vulnerability' classification as set out in PPG.

Basements represent a particularly high risk to life within flood hazard areas as they may be subject to very rapid inundation as floodwater moves across the floodplain. This rapid inundation could result in a risk to life. The Article 4 Direction does not prevent basement developments from occurring, but requires the applicant to apply for planning permission. In order to be granted permission, developers and applicants need to submit a site-specific FRA to demonstrate that the development can manage flood risk effectively and prevent an increase in the risk to life. The Article 4 Direction boundary is

comprised of the tidal defence breach hazard and fluvial hazard extents for tidal and fluvial flood risk respectively. Article 4 Direction data can be viewed as part of the *Policy Web Map*. Further guidance on requirements for basement developments and site-specific FRAs can be found in *Section 6*.

5.6 Groundwater Flood Risk

Groundwater flooding occurs because of the underground water table rising, which can result in water emerging through the ground and causing flooding. This source of flooding tends to occur after extensive periods of heavy rainfall, potentially occurring for weeks or months. During these periods, a greater volume of water infiltrates through the ground, causing an underlying aquifer to rise above its regular depth below the ground's surface. Springs and low-lying areas, where the water table is likely to be closer to the surface, pose greater risk of groundwater flooding. Groundwater flooding can occur in areas where the underlying soil and bedrock can become saturated with water. Therefore, ground composition and aquifer vulnerability are significant influences on the potential rate of groundwater flooding.

The bedrock geology for the entirety of the London Borough of Richmond upon Thames is London Clay, a geology type comprised of clay and silt, and one with very low permeability. This geological unit generally has a low hydraulic conductivity, which means water does not easily move through it. However, because of this characteristic and poor drainage, ponding can occur if aquifer outcrops are located uphill of areas only underlain with London Clay.

The superficial geology for the London Borough of Richmond upon Thames is predominantly a range of different river terrace deposits, including the Kempton Park Gravel Member, Taplow Gravel Member, Boyn Hill Gravel Member, and Black Park Gravel Member. Each of these geological units are comprised of sand and gravel, geology with a higher hydraulic conductivity than those comprised of clay and silt. The other dominant superficial geology type is the Langley Silt Member, a geological unit comprised of clay and silt. Water moves less easily through this geology as it has a low hydraulic conductivity. Area-specific information on groundwater flood risk and geology is shown in Groundwater, Sewer and Artificial Flood Risk Web Map.

Subterranean conditions in certain areas throughout the London Borough of Richmond upon Thames are also at risk of groundwater influenced flooding via throughflow. Groundwater travels downhill through the aquifers/permeable superficial deposits from the top of the catchment area. In locations where there are no aquifers/permeable superficial deposits for water to flow through, water continues to flow through the interface of the made ground subsurface level and the clay geology stratum. This is referred to as throughflow. For further information on throughflow and the borough-wide groundwater influenced investigations, see *Section 7.3*.

5.6.1 Impacts of climate change

Groundwater flooding is currently not modelled, therefore there are no predicted maps demonstrating how groundwater flood risk may change with climate change. However, there are a number of potential ways in which climate change could impact groundwater flood risk. Rainfall intensity and duration variability could lead to a long-term decline in groundwater storage and an increase in groundwater drought periods and severity. The EA's UK climate change projections for peak rainfall intensity predicts rainfall intensity to increase during rainfall events. This could result in an increased frequency and severity of groundwater-related floods.

5.7 Sewer Flood Risk

Sewer flooding can occur due to drainage system infrastructure failure. Flooding can also occur due to an increased flow and volume of water entering a sewer system, resulting in the system exceeding its hydraulic capacity and surcharging as a result. If sewer outfall points are either blocked or submerged due to high water levels, water can back up in a sewer system and cause flooding. These issues can result in water overflowing from gullies and manholes, causing flooding in the local area. Blockages caused by sediment or debris can further exacerbate the probability of sewer flooding.

Wastewater sewerage in the London Borough of Richmond upon Thames is serviced by TWUL. The borough is predominantly served by separate surface water and foul sewer systems. Modern sewer systems are designed to be separate systems, typically accommodating up to 1 in 30 year rainfall events in surface water sewers. However, sewer system segments across London vary in capacity due to age. Older segments have a smaller capacity and may not be designed to accommodate rainfall events as significant as 1 in 30 year events. TWUL have responsibilities for all 'public sewers' (the drainage network which serves more than one property, including associated manholes) under the *Water Industry Act 1991*. Typically gullies or drains and the interconnecting pipework which drain into sewers are the responsibility of the private landowner or, for those draining the highway, the Highways Authority. Due to the interconnection between these different assets, any associated flooding may be caused by a combination of factors, therefore all relevant parties should be involved in subsequent investigations and, where necessary, work to resolve the root cause.

Consideration needs to be given to the existing sewer network as part of all new development proposals. Local Plan Policy LP 23 requires that applicants for major developments provide evidence in the form of written confirmation as part of the planning application that capacity exists in the public sewerage and water supply network to serve their development. As new developments are added into the catchment area additional capacity stress is applied to sewers, increasing the chance of them becoming overloaded. Sewer flood risk is something that can therefore increase throughout the borough. The Groundwater, Sewer and Artificial Flood Risk Web Map contains information regarding recorded sewer flood incidents.

5.7.1 Impacts of climate change

The predicted impacts of climate change on sewer flood risk are closely linked to potential changing rainfall patterns and intensity, as well as changes in surface water flood risk. Based on the EA's UK climate change projections for peak rainfall intensity, the UK can expect an increase in rainfall intensity during rainfall events. This would increase the flow and volume of water attempting entry into the drainage system, increasing the chances of service overload. Service overload can result in surface water surcharging, resulting in localised flooding above ground. It can also result in an increase in untreated wastewater overflows entering the environment through combined sewer overflows into rivers, causing widespread damage.

5.8 Artificial Sources Flood Risk

Artificial flooding can occur as a result of infrastructure failure or human intervention. Artificial flood sources include reservoirs, canals, water retention ponds, docks and other artificial structures. The probability of a structural breach is low; however, the potential extent of damage is significant. Artificial source failure could leave many properties at risk of flooding.

The Groundwater, Sewer and Artificial Flood Risk Web Map shows the risk of flooding from reservoirs. It shows the largest area that could potentially flood if a reservoir were to fail and release the water it holds.

Information presented on the Web Map displays the worst-case scenario, providing data that could be used for emergency planning purposes. For further details on emergency planning and other FRA requirements, refer to *Section 6.1*.

5.8.1 Impacts of climate change

Due to the complex nature of reservoirs and other large artificial infrastructure, the potential impacts of climate change on these structures are complex and varied. Climate change could result in extreme fluctuations in water levels due to changes in frequency and intensity of rainfall. This could therefore have a knock-on effect on reservoir yields.

5.9 Residual Risk of Flooding

5.9.1 Tidal breach

The TTD offers significant protection against flooding from tidal sources; however, risk still remains. Overtopping or failure of the Thames Barrier and other flood defence assets could occur. Defences can also be overtopped due to wind and wave actions. In addition, structural failure of TTD assets can lead to these features being breached. The Fluvial and Tidal Flood Risk Web Map shows the potential extent of inundation, including maximum likely water level, that could occur due to tidal flood defence breach and thus accounting for the residual risk.

For proposed developments within the breach range of the River Thames, an assessment analysing the residual risk should be considered as part of an FRA. The probability of residual risks linked to overtopping and flood defence asset failure is small; however, the potential damage extent and potential risk to life is significant. *Section 6.1* of this document contains further information on development requirements.

5.9.2 Flood warnings and alerts

The EA provides a Flood Warnings and Alerts information service covering the main rivers in and around the London Borough of Richmond upon Thames. Residents can sign up to the free warnings service by phone, e-mail or text message if their home or business is at risk of flooding.

The EA issues Flood Warnings and Alerts to specific areas when flooding is possible (flood alerts) or when flooding is expected (flood warning or severe flood warning) This enables the EA, residents and businesses to prepare as required to mitigate against the potential impacts of tidal and fluvial flooding. Severe flood warnings are where there is potential for risk to life.

The River Crane and Beverley Brook have smaller hydrological catchments compared to the River Thames. This makes them more 'flashier systems' that respond faster to hydrological changes. As a result, these catchments may have shorter lead times for flood warnings and alerts.

5.10 Historic Flooding

The London Borough of Richmond upon Thames has historic flooding information for a number of different flood sources. The EA's 'Historic Flood Map' dataset shows the maximum extent of all individual recorded flood outlines in the borough. TWUL's 'Internal Flood Incidents (No. of incidents by partial postcode)' dataset also provides historic flooding information on flood incidents reported to TWUL. The EA's 'Historic Flood Map' dataset can be viewed as part of the Fluvial and Tidal Flood Risk Web Map, whilst TWUL's 'Reported Flooding Incidents' dataset can be viewed as part of the Groundwater, Sewer and Artificial Flood Risk Web Map.

Developers and prospective applicants are advised to review these as part of the planning application process. Developers and applicants are also advised to review the PFRA, LFRMS and SWMP for more information. If there are any queries regarding the records, they are advised to contact Richmond upon Thames' LLFA. For further FRA guidance, see *Section 6.1*.

5.11 Flood Hazard

The London Borough of Richmond upon Thames recognises that flooding poses risk a to life, not just property. It is recognised that the degree of hazard presented by flood risk sources to people and property is a function of both velocity and depth.

The risk to life posed by fluvial and tidal flood risk within the borough has been assessed and delineated in accordance with the DEFRA and EA guidance provided in the FD2321/TR1 The Flood Risks to People Methodology. The risk posed by surface water has been assessed and delineated in accordance with the EA's What is the Risk of Flooding from Surface Water Map guidance. For all three flood risk sources, the Flood Hazard assessment is a method that combines predicted depth and velocity into a 'hazard rating' that can be used to define the level of risk to people.

The hazard mapping for fluvial flood risk has been updated in response to the EA's River Thames 2019 (Hurley to Teddington) (fluvial) modelling. Developers and prospective applicants can request further hazard information from the EA's Customers and Engagement Team (Thames Area). The hazard rating for surface water uses an additional factor known as the Debris Factor (DF). The DF is a value of either 0, 0.5, or 1, that accounts for debris potentially increasing the hazard posed by surface water flooding. This information can be used to help steer development to areas of lower risk. *Table 5-2* and *Table 5-3* presents information for fluvial and tidal, and surface water flood risk respectively.

Table 5-3Table 5-2. Fluvial and Tidal Hazard to People as a Function of Velocity and Depth

Numerical Hazard Rating D * (V + 0.5)	Flood Hazard	Description
< 0.75	Low	Caution
0.75 – 1.25	Moderate	Dangerous for some people
1.25 – 2.5	Significant	Dangerous for most people
> 2.5	Extreme	Dangerous for all

Table 5-3. Surface Water Hazard to People as a Function of Velocity, Depth and Debris Factor

Numerical Hazard Rating D * (V + 0.5) + DF	Flood Hazard
0.5 – 0.75	Low
0.75 – 1.25	Moderate
1.25 – 2.0	Significant
> 2.0	Extreme

6 FLOOD RISK ASSESSMENT GUIDANCE

6.1 Overview

Developers, applicants and LPAs need to consider flood risk to and from proposed development as part of any planning proposal. To assess the flood risk to and from a development, a site-specific FRA and/or Statement on SuDS should be carried out by the developer, applicant or a party representing the developer. The site-specific FRA and/or Statement on SuDS should demonstrate that the proposed development will manage different sources of flood risk now and over the development's lifetime (i.e., 100 years for residential development and 60 years for commercial). Developers and/or applicants should justify the timescale for the lifetime of the proposed development. It needs to be demonstrated that the development will not be at risk of flooding or increase flood risk elsewhere. Developments must also be appropriately resilient to the potential impacts of climate change. Complying with the NPPF, and policies from the current London Plan (Policy SI 13) and Richmond upon Thames's Local Plan (Policy LP 21), developers and applicants have to prioritise SuDS when proposing drainage measures to reduce local flood risk. Measures that manage runoff as close to source as possible and contribute to the four main pillars of SuDS (amenity, biodiversity, water quality and water quantity) should be proposed where possible. These key principles need to be applied at the strategic level for borough-wide planning and at the site level for development proposals and site allocations.

The site-specific FRA and/or Statement on SuDS should be submitted as part of the planning application for a proposed development for consideration. As the LPA, Richmond upon Thames will undertake a period of consultation to review the proposal, referring to internal and external consultees as required. If the submitted site-specific FRA and/or Statement on SuDS required is deemed unsatisfactory, the application should be recommended for refusal as providing satisfactory documentation is a national policy requirement.

The London Borough of Richmond upon Thames has published its Local Validation Checklist for planning applications. The document provides details on planning application requirements, including information on site-specific FRAs and SuDS. Richmond upon Thames also provides details on SuDS and the Sustainable Drainage Proforma that must accompany all major developments. The information provided in Tables *6-1* and *6-2* supplements this information, providing further requirements and considerations that must be addressed as part of the planning application submission.

Developer and Applicant (*Section 6.3*), LPA Development Management (*Section 6.4*) and Planning Policy (*Section 6.5*) specific guidance regarding FRAs is available in this section. Town Centres, Local Centres, and Islands specific (*Section 6.2*) and Emergency Planning (*Section 6.6*) guidance is also provided.

6.1.1 Sequential and Exception Tests

The NPPF requires that a sequential, risk-based approach to the location of development is taken to avoid, where possible, the risk of flooding to people and property. The approach needs to take both current and future impacts of climate change into account. To demonstrate that efforts have been made to steer development to areas with the lowest risk of flooding, developers and applicants may be required to carry out the Sequential and Exception Tests as part of the site-specific FRA and/or Statement on SuDS.

The Sequential Test requires that proposed development sites are located within areas of lowest flood risk. Only if it can be demonstrated that there are no suitable sites within the wider search area then alternative sites (i.e., within areas that may potentially be at risk of flooding) can be considered. For

this SFRA, the wider search area is defined as the entire borough extent, though there are locally defined search area exceptions depending on the location of the proposed development. Further information on search area exceptions can be found in *Section 6.2* and *Section 6.3.1*.

The NPPF recognises that it may not always be possible to locate development in areas with a lower risk of flooding. These developments may be proposed in established communities that require continued development to grow. For these types of proposals, the NPPF provides the Exception Test. The Exception Test is a method to demonstrate and help ensure that flood risk to people and property will be managed satisfactorily, while allowing necessary development to go ahead in situations where suitable sites at lower risk of flooding are not available. To pass the Exception Test, the following two conditions need to be passed in line with paragraph 160 of the NPPF:

- the development would provide wider sustainability benefits to the community that outweigh the flood risk; and
- 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.

For Town Centre, Local Centre and Island specific application of the Sequential Test in Richmond, see *Section 6.2*. For further developer and applicant guidance on applying the Sequential and Exception Test, see *Table 6-1* and *Section 6.3*. LPA Development Management and Planning Policy guidance on the Sequential and Exception Tests can be found in Section *6.4* and *6.5* respectively.

6.1.2 Planning Application and Development Requirements

Table 6-1 provides the planning application and development requirements that must be addressed as part of the flood risk and drainage strategy submission documents. The guidance is applicable for Major, Minor, and Change of Use and Changes Under Prior Approval Notifications developments, with development type-specific guidance highlighted where applicable. *Table 6-2* provides the requirements for the assessment and management of flood risk from other sources where applicable. The information presented in Tables *6-1* and *6-2* are a mixture of legislative and best-practice requirements from various sources, including the NPPF, PPG, current London Plan, and the Richmond upon Thames Local Plan. In some instances, the SFRA guidance and recommendations herein go beyond existing adopted policies at the time of writing (March 2021). This includes policy guidance on where Statement on SuDS are required, and where specific information is needed to address flood emergency and basement requirements. Further guidance is available via the PPG Site-specific FRA Checklist and the EA's Standing Advice.

Table 6-1. Planning Application and Development Requirements for **All Developments** (Flood Zones 1, 2, 3a and 3b)

Requirement Area	Flood Zone 3b	Flood Zone 3a	Flood Zone 2	Flood Zone 1
Planning Permission and Permitted Developments	Planning permission is required if the work being carried out meets the Section 55 of the Town and Country Planning Act 1990 definition of a 'development'. Section 57 of the Town and Country Planning Act 1990 states that all work falling under this statutory definition of 'development' requires planning permission unless it meets permitted development criteria.			
Development Types and Definitions (as defined by gov.uk)	The following are planning application definitions for development types: • **Major Developments**: For residential developments, 10+ dwellings or site area over 0.5 hectares. For non-residential developments, total building floorspace exceeds 1,000m^2 or site area over 1 hectare. • **Minor Developments**: For residential developments, 1-9 dwellings, site area under 0.5 hectares. For non-residential developments, total building floorspace is less than 1,000m^2, site area under 1 hectare. • **Change of Use**: Developments classified as a 'Change of use' if - (i) the application does not concern a major development; and (ii(a)) no building or engineering work is involved; or (ii(b)) the building or engineering work would be permitted development were it not for the fact that the development involved a change of use (such as the removal of internal dividing walls in a dwelling house to provide more spacious accommodation for office use).			
Documentation Requirements and Considerations (Richmond upon Thames Requirement)	The information supplied in a site-specific FRA and / or Statement on SuDS for any development should be proportionate to the identified flood risks and appropriate to the scale, nature and location of the development. For example, major developments by definition are typically larger in scale compared to minor developments, therefore flood risk assessment documentation for major developments should be more detailed in comparison to reflect their size and impact.			
Land Uses and Development Restrictions (Information is from the Flood Risk and Coastal Change PPG)	The Flood Risk Vulnerability and Flood Zone Compatibility table in the PPG highlights that only 'Essential Infrastructure' and 'Water Compatible' developments may be granted planning permission. As the functional floodplain, land in Flood Zone 3b will be protected by not permitting any form of development on undeveloped sites unless it is for 'Water Compatible' development or 'Essential Infrastructure'. Redevelopment of existing developed sites will only be supported if there is no intensification of the land use and a net flood risk reduction is proposed; any restoration of the functional floodplain will be supported (see 'Flood Compensation Storage' section of this table). Proposals for the **change of use or conversion** to a use with a higher vulnerability classification will not be permitted.	The Flood Risk Vulnerability and Flood Zone Compatibility table in the PPG highlights that land use is restricted to 'Water Compatible', 'Less Vulnerable' and 'More Vulnerable' development. 'Highly Vulnerable' developments will not be permitted as it is not a permitted development type in Flood Zone 3a. Self-contained residential basements and bedrooms at basement level will not be permitted (see 'Basements' section of this table).	No land use restrictions. Self-contained residential basements and bedrooms at basement level will not be permitted (see 'Basements' section of this table).	No land use restrictions

Sequential and Exception Tests (Information is from Policy LP 21 of the Local Plan – *Refer to Section 6.2.1 and Section 6.3.1 for specific guidance on the application of these at the site-specific scale*)	The Sequential and Exception Tests do not need to be applied if your site:
	• Is a '**minor development** in relation to **flood risk**':
	  ○ industrial/commercial/leisure etc extensions with a footprint less than 250 m^2.
	  ○ development that does not increase the size of buildings, e.g. alterations to external appearance.
	  ○ householder development within the curtilage of the existing dwelling (e.g. sheds, garages, games rooms), in addition to physical extensions to the existing dwelling itself.
	• Is a **change of use development** – excluding caravans, camping chalets, mobile homes and park home sites.
	The Sequential and Exception Tests need to be applied for all **major developments** and **minor developments** as set out below.			

	Developments categorised as 'Essential Infrastructure' can only be considered following applications of the Sequential and Exception Tests. Paragraph 15 of the PPG states: *"If an area is intended to flood, then this should be safeguarded from development and identified as functional floodplain, even though it might not flood very often. Development can only be permitted following application of the Sequential Test, and a successful application of the Exception Test."*	The Sequential Test is required for all developments except for development proposals categorised as 'Highly Vulnerable' – 'Highly Vulnerable' development is not permitted (see 'Land Uses and Development Restrictions' section of this table). Developments categorised as 'Essential Infrastructure' and 'More Vulnerable' can only be considered following application of the Exception Test.	The Sequential Test is required for all development types. Developments categorised as 'Highly Vulnerable' can only be considered following application of the Exception Test.	The Sequential Test only needs to be applied for development proposals in Flood Zone 1 if the SFRA and accompanying Web Map indicates there may be existing flood issues from other sources (refer to *Table 6-2*) or flood issues in the future. This information may also come from other sources.
	Development proposals within a Town Centre, Local Centre or Island development zone have a specific locally defined Sequential Test approach and set of development requirements. Please see *Section 6.2* for further details.			
Site-specific FRA (Information is from Policy LP 21 of the Local Plan – *Refer to Section 6.2.2 for further guidance)*	A site-specific FRA is required for all development proposals. Site-specific FRAs in Flood Zone 3b must also demonstrate that: • Infrastructure will remain safe and operational for users during flood periods. • The development will not impede flowing water. • There will be no net loss of floodplain storage (see the 'Flood Compensation Storage' section of this table). • Flood mitigation measures will reduce the overall flood risk of the site.	A site-specific FRA is required for all development proposals. Site-specific FRAs in Flood Zone 3a must also demonstrate that there will be no net loss of floodplain storage (see the 'Flood Compensation Storage' section of this table). Flood risk from all sources should be assessed, including the potential impacts of climate change over the development's lifetime. The EA's 2016 climate change allowances (including subsequent updates) must be used when assessing peak river flows, sea level rises and peak rainfall intensities.	A site-specific FRA is required for all development proposals. Assessment needs to demonstrate the reduction of flood risk at the site through various mitigation techniques. Flood risk from all sources should be assessed, including the potential impacts of climate change over the development's lifetime. The EA's 2016 climate change allowances (including	A site-specific FRA is required for all development proposals where there is evidence of a risk from other sources of flooding, including surface water, groundwater and sewer flooding. Flood risk from all sources should be assessed, including the potential impacts of climate change over the development's lifetime. The EA's 2016 climate change allowances (including subsequent updates) must be used when assessing

Requirement Area	Flood Zone 3b	Flood Zone 3a	Flood Zone 2	Flood Zone 1
	Flood risk from all sources should be assessed, including the potential impacts of climate change over the development's lifetime. The EA's 2016 climate change allowances (including subsequent updates) must be used when assessing peak river flows, sea level rises and peak rainfall intensities.		subsequent updates) must be used when assessing peak river flows, sea level rises and peak rainfall intensities.	peak river flows and peak rainfall intensities. Assessments of tidal flood risk should use the current TE2100 Plan crest levels guidance and breach modelling (see *Section 4.2.2* for further information).
	If the site for a development proposal falls within the 1 in 100 year surface water extent (based on the *Surface Water Flood Risk Web Map*), the applicant is required to submit an FRA as part of a planning application. This is a requirement for all **major developments**, **minor developments**, and **change of use developments** that have a bearing on a site's existing drainage regime.			
	Where a site-specific FRA is required, predicted flood depths should be analysed and appropriately mitigated. Mitigation may include (but not be limited to) flood resistance measures (where predicted flood depths are less than 0.3m) or flood resilience measures (where predicted flood depths are greater than 0.6m). Predicted flood depths between 0.3m and 0.6m should be analysed on a case-by-case basis to determine if resistance measures are sufficient. Design plans should show floor levels (relative to Ordnance Datum) and predicted flood depths.			
Statement on SuDS *(Refer to Section 7.2.3 for further guidance)*	A Statement on SuDS is required for all **major developments**. **Minor developments** and **change of use developments** that have a bearing on a site's existing drainage regime also need to provide a Statement on SuDS as part of the development proposal.			
	The Statement on SuDS requires information on the proposed SuDS and surface water runoff discharge destination in line with Policy LP 21 of the Richmond upon Thames Local Plan and Policy SI13 'Sustainable drainage' of the current London Plan. Each stage of the drainage hierarchy should be appropriately assessed with supporting information to demonstrate if measures could be implemented as high up the hierarchy as possible. The Statement on SuDS also requires supporting calculations on the greenfield and proposed development's peak discharge rates, and water storage volumes for different rainfall events with climate change allowances. These calculations need to ensure that proposed developments are designed to the Non-Statutory Technical Standards for Sustainable Drainage Systems. Maintenance and operation requirements must be designed into the proposals to ensure lifetime management of the SuDS features, in accordance with Written Ministerial Statement HCWS161. A Richmond upon Thames Sustainable Drainage Proforma needs to be provided for all major development planning applications. SuDS need to be designed with the landscape features of the development site in mind, maximising additional benefits including, but not limited to, environmental, water quality and amenity enhancement. Permission to connect to the local sewer network and pipes, including written confirmation that capacity exists in the network, should be sought from TWUL in line with Local Plan policy LP 23 'Water Resources and Infrastructure'. Evidence demonstrating that an agreement in principle for any proposed new sewer connections has been reached must be provided as part of the Statement on SuDS. Failure to do so could impact the detailed design and overall Statement on SuDS for the site. The requirement to confirm local sewer network connections is for **major developments** only.			
Basements (Information is from Policy LP 21 of the Local Plan)	Basements, basement extensions, conversions of basements to a higher vulnerability classification or self-contained units will not be permitted.	In areas of Extreme, Significant and Moderate Breach Hazard (See *Section 5.11* for definitions): • New basements: ○ restricted to 'Less Vulnerable' and 'Water Compatible' use only. ○ 'More Vulnerable' uses will only be considered if a site-specific FRA demonstrates that the risk to life can be managed. Bedrooms at basement levels will not be permitted. ○ 'Highly Vulnerable' uses such as self-contained basements/bedrooms will not be permitted. • Existing basements: ○ No basement extensions, conversions or additions for 'Highly Vulnerable' uses. ○ 'More Vulnerable' uses will only be considered if a site-specific FRA demonstrates that the risk to life can be managed. In areas of Low or No Breach Hazard: • New basements: if the Exception Test (where applicable) is passed, basements may be permitted for residential use where they are not self-contained or used for bedrooms. • Existing basements: basement extensions, conversions or additions may be permitted for existing developments where they are not self-contained or used for bedrooms. If a basement, basement extension or conversion is acceptable in principle in terms of its location, it must have internal access to a higher floor and flood resistant and resilient design techniques must be adopted. These measures should comply with the 1 in 100 and 1 in 200 year return period events for fluvial and tidal flooding respectively as per Flood Zone 3a. These measures should also include climate change considerations.	In areas of Low or No Breach Hazard (See *Section 5.11* for definitions): • New basements: if the Exception Test (where applicable) is passed, basements may be permitted for residential use where they are not self-contained or used for bedrooms. • Existing basements: basement extensions, conversions or additions may be permitted for existing developments where they are not self-contained or used for bedrooms. If a basement, basement extension or conversion is acceptable in principle in terms of its location, it must have internal access to a higher floor and flood resistant and resilient design techniques must be adopted. These measures should comply with the 1 in 1000 year return period event for both fluvial and tidal flooding as per Flood Zone 2. These measures should also include climate change considerations.	No restrictions on new or extensions to existing basements for fluvial and tidal flooding. Where there is evidence or previous occurrences of flood risk from surface water, groundwater and / or sewer flooding in the area, a site-specific FRA is required for new and existing basement proposals. The *Basement Assessment User Guide* and the *Further Groundwater Investigations* (2020 with minor updates in 2021) should be used to help demonstrate that the development will not be impacted by flooding, or have any adverse impacts on flooding locally. Flood mitigation measures should be proposed as required.
	Developments within areas that are at increased risk of flooding due to groundwater and/or throughflow flood mechanisms (see *Section 7.3*) require further analysis of flood risk. Applicants are required to ensure that proposed subsurface developments do not increase the risk of throughflow and groundwater related flood risk in the immediate area via a Screening Assessment and, if required, a Basement Impact Assessment. See section 'Groundwater & Throughflow Flooding' in *Table 6-2* for further details.			
Finished Floor Level (EA Planning Requirement)	For new developments, finished floor levels are set no lower than 300 millimetres above the 1 in 100 year return period event flood level for fluvial flooding. This includes an allowance for climate change.			N/A

Requirement Area	Flood Zone 3b	Flood Zone 3a	Flood Zone 2	Flood Zone 1
	For tidal flood risk, the finished floor levels of all developments are set above the modelled Thames tidal breach flood level for the year 2100. As a minimum, any sleeping accommodation must be located above this breach level.			
Flood Compensation Storage (Information is from Policy LP 21 of the Local Plan)	Flood compensation requirements are for **major developments** and **minor developments** only. If permissible development decreases the volume of a fluvial floodplain, flood storage compensation needs to be provided. The compensatory storage provided must be equal to or exceed the storage lost to ensure there will be no net loss of flood storage. Compensation should be provided on a level-for-level and volume-for-volume basis. The EA's 2016 climate change allowances (including subsequent updates) must also be incorporated to assess and calculate floodplain storage compensation. In most cases, the 'higher central' allowance should be used to calculate floodplain storage compensation. However, the 'upper end' allowance should be used if: • The catchment is particularly sensitive to small changes in volume. • affected area contains essential infrastructure or vulnerable uses.		N/A	N/A
Voids (EA Planning Requirement)	Voids may be applicable for **major development** and **minor development** proposals only. If permissible development decreases the volume of a fluvial floodplain and flood compensation storage cannot be provided, introducing voids may be a suitable alternative. Voids are generally considered to provide indirect compensation for loss of floodplain storage. Voids may be suitable where it is not possible to achieve all the direct compensation required or for small scale development where it can be difficult to achieve full compensation. Ideally, void openings should be a minimum of 1m long and open from existing ground levels to at least the 1% annual probability (1 in 100 year) fluvial, or the 0.5% annual probability (1 in 200 year) tidal, plus climate change flood level. By setting finished floor levels at 300mm above the design flood level, there is usually enough space for the provision of voids below. There should be a minimum of 1m of open void length per 5m length of wall. Void openings should be provided along all external walls. If security is an issue, 10mm diameter vertical bars set at 100mm centres can be incorporated into the void openings. The use of under-floor voids will typically require a legal agreement or planning condition and maintenance plan to ensure they remain open for the lifetime of the development. For small scale development different design criteria may be acceptable. Sole reliance on the use of under-floor voids to address the loss of floodplain storage capacity is not acceptable on undeveloped sites.		N/A	N/A
Emergency Planning (Information is from Policy LP 21 of the Local Plan and the Flood Risk and Coastal Change PPG)	Flood Emergency Plans are required for all **major developments** and for **minor developments** where safe access/egress cannot be achieved and demonstrated as part of the FRA. Flood Warning and Emergency Plans need to feature measures to manage flood risk before, during, and after a flood, reducing the potential human impact of any flood event and making developments as resilient to flooding as possible. These plans need to be detailed and up to date, addressing the risks local to the site. The PPG highlights several important considerations, helping to define some key requirements including: • Details of all the flood risk sources present at the proposed development site. • Adequate flood warning procedures for people accessing the development. • Potential mitigation measures following an assessment of the risks, including appropriate flood resistance or resilience measures to address predicted flood depths. • Information regarding safe access and egress points across the site, ensuring that they remain so during flooding. These points need to be maintained over the development's lifetime. • Suitable evacuation plans that consider the impact of climate change. These evacuation plans need to feature adequate routes and refuge areas for people to be taken to, accounting for the potential length of time of the evacuation. Developments categorised as 'Less vulnerable' are required to use the 'higher central' allowance as per the EA's 2016 climate change allowances as the basis for designing safe access, escape routes and places of refuge. Where the site is on a 'dry island' (area within a flood risk area that is surrounded by areas at higher risk of flooding) but not necessarily at high risk itself, an emergency plan must still address this risk and provide appropriate management measures. If the planning application is permitted, the onus to train, test and implement the stated measures become the responsibility of the applicant and ultimately the building owner, management company, or the adopter of a site for temporary use.			
	PPG defined 'Essential Infrastructure' and 'Water Compatible' use development needs to remain operational and safe in times of flood. Emergency Plans need to reflect this as these structures may assist in flooding evacuations.	PPG defined 'Essential Infrastructure' use development needs to remain operational and safe in times of flood. Emergency Plans need to reflect this as these structures may assist in flooding evacuations.	-	-
Residual Risk (Information is from the Flood Risk and Coastal Change PPG)	As part of the second criteria of the Exception Test, there is a requirement to show that proposed developments are safe and that any residual risks can be satisfactorily overcome. Residual risk should be mitigated through flood resilient / resistant designs and emergency planning to make sure suitable measures are in place to offer protection.			
Main River Buffer Zone (Information is from Policy LP 21 of the Local Plan)	Developments should be set back from riverbanks and existing flood defence infrastructure where possible (16m for the tidal Thames and 8m for other rivers). Developments sites within specified distances of main rivers may require a flood risk activity permit in addition to planning permissions. For non-tidal main rivers, flood risk activity permits may be required if development sites are within 8m of a river, flood defence structure or culvert. For tidal main rivers, flood risk activity permits may be required if development sites are within 16m of a river, flood defence structure or culvert. Further details on flood risk activity permits are available from the Environment Agency.			
Ordinary Watercourse Buffer Zone (Richmond upon Thames Requirement)	Development sites within 5m of ordinary watercourses may require an approved ordinary watercourse consent in addition to planning permissions. The consent, a variation of Section 23 of the Land Drainage Act 1991, is regulated and enforced by Richmond upon Thames.			
Defence Raisings – Tidal (EA Planning Requirement)	It is the riparian landowner's responsibility to maintain the flood defences. Future defence raisings are required in line with the TE2100 Plan crest levels guidance. Planning applications that fall within the boundary of a flood defence need to consider the lifetime of the development and the status of current flood defence crest levels in the site-specific FRA. This will form part of the Exception Test as to whether a development is made safe for its lifetime. A site-specific FRA will be required to demonstrate either how the flood defences will be raised now or a plan of how the flood defence will be raised in the future to meet the demands of climate change, in line with the TE2100 Plan.			

Table 6-2. Planning Application and Development Requirements for **Individual Sites** (Other Flood Risk Sources)

Flood Risk Source	Planning Application and Development Requirements
Groundwater & Throughflow Flooding	Required for all **major** development and **minor** developments that alter the surface or sub-surface level footprint or arrangement of a site. If the proposed development includes a **basement** development, then a Basement Screening Assessment will need to be carried out (further information below). Where a development site intersects with an area with >= 25% susceptibility to groundwater flooding, the applicant should assess this risk by answering the following questions: • Will the proposed development impact the flow profile of groundwater related flow or surface water to downstream areas? • Will the proposed development increase groundwater related flood risk to neighbouring properties? If the answer to either, or both, of these questions is 'yes', then the applicant should assess the potential impacts and level of risk posed by the development. Such an assessment may identify that the proposed development requires mitigation actions. All of this must be detailed as part of the applicant's submission. As a guide, the assessment could align with the approach as set out in the *Basement Assessment User Guide*. **Where the development includes a basement**, a Basement Screening Assessment (as a minimum) should be carried out if the proposed development falls within one (or both) of the following borough designations: • An area with >= 25% susceptibility to groundwater flooding. • One of the four throughflow catchment areas. If the Screening Assessment (as per the *Basement Assessment User Guide*) identifies any potential issues which would require a more detailed investigation into the suitability of the proposed development, then a Basement Impact Assessment should be carried out. As part of answering the Screening Assessment questions and establishing if a Basement Impact Assessment is required, applicants are required to provide information to justify their answers to the Screening Assessment questions. Examples of information that is expected as part of the Screening Assessment include, but is not limited to: • Description of the proposed basement, cellar or subsurface structure development. • Construction methods proposed. • Characteristics of the site, including geological information (bedrock, superficial deposits, and aquifer confirmation) and topographical information. • Site borehole information with water levels. If historical borehole data is used, the borehole location must be within 100m of the site and have been conducted within the last 20 years to best capture the current local conditions. However, singular borehole measurements may not provide information on what subterranean conditions might look like at a different time in the year. Groundwater flow and throughflow may be subjected to seasonal influences. Therefore, it will be necessary to monitor subterranean water levels over a period of time in areas that may be more susceptible to groundwater and throughflow. • Characteristics of potential impacts (including the impact on soils, land use, water quality and hydrology). • Details of mitigation measures (where appropriate). The *Groundwater, Sewer and Artificial Flood Risk Web Map* provides the locations of the throughflow catchment areas and the >= 25% groundwater susceptibility information. The *Basement Assessment User Guide* and the *Further Groundwater Investigations* (2021) report provides details of the questions which should be addressed as part of the Basement Screening Assessment. Both reports also provide further details on the Basement Impact Assessment requirements, including the need for detailed borehole analysis within at least a 12 month period to demonstrate any potential seasonal variations, and, if required, mitigation measures.
Sewer Flooding	Where the development site intersects with an area defined as having one or more sewer flooding records, the applicant must consult with the relevant Water and Sewerage Company to confirm if the development site has historically flooded. Where historic flooding has occurred, the applicant must show how they will effectively manage this risk for the lifetime of the development. This is required for all **major** and **minor** development proposals. Where the site is not at risk, the applicant must demonstrate that the Water and Sewerage Company has agreed in principle to any proposed new sewer connections.
Artificial Sources Flooding – Canals	Required for all **major** and **minor** development proposals. If the application site is within 100m of an existing canal, the applicant must assess if any failure of the canal structure could result in flooding of the development site. This only requires a comparison of relative levels of the canal structure and the site – however, if the site is potentially at risk, then the applicant will need to consult with the Canal & River Trust to determine the condition of the local structure and propose proportionate management measures within their site (similar to residual risk management measures outlined in *Table 6-1*).
Artificial Sources Flooding – Reservoirs	Required for all **major** and **minor** development proposals at risk of flooding from reservoirs. Where the application site intersects the area defined to be at risk of flooding from reservoirs, the applicant must: • Identify which reservoirs are the sources of risk (available from the *Groundwater, Sewer and Artificial Flood Risk Web Map*). • Where the site is encircled by flood water, but not necessarily at risk itself, the implications of this must be addressed in the risk management measures proposed. • Propose appropriate and proportionate risk management measures.
Artificial Sources Flooding – Other	Other sources of artificial flood risk may include small lakes or ponds. Where these exist within, or are immediately adjacent to, the development site, the applicant must identify them and propose risk management measures as appropriate. This is required for all **major** and **minor** development proposals.

6.2 Town Centres, Local Centres and Islands

6.2.1 Local Sequential Test Approach

In line with local policy and requirements, the London Borough of Richmond has adopted its own Sequential Test approach and development requirements for Town Centres and Local Centres in the borough. For guidance on development proposals in other areas, please see *6.3*.

Many of the borough's properties are located in and around town centres and local centres. Some centres are located in Flood Zones 2 and 3, however relocating development away from these centres and their immediate surrounding vicinity is not always a realistic option due to the community role these areas play in the borough. In order to sustain the continuing role of these centres, development can be used as a way to help manage and reduce flood risk in these areas. Therefore, an EA approved local Sequential Test approach has been developed.

The local Sequential Test approach is applicable for town centres, local centres, and areas that fall within the 800m buffer boundary for each centre. An 800m buffer was selected as it is considered a community sustaining walking distance for a person not living with/having a physical disability. The Policy Web Map provides the location of the designated centres and their 800m buffers.

The local approach dictates that the Sequential Test will not be required if the development proposal meets at least one of the following:

- It is within a town centre or local centre boundary.
- It is for residential development or a mixed-use scheme and within the 800m buffer area identified within the town centre or local centre

The Borough's town centres and local centres are set out as part of the 'centre hierarchy' which is linked to Policy LP 25 of the Local Plan. For further information on town centres and local centres, see Sections *6.2.2* and *6.2.3* respectively.

The local Sequential Test approach is also applicable for certain development proposals outside of the requirements above. As per LP 21 of the Local Plan, the Sequential Test will not be required if the proposed development:

- Is a site allocation in the Local Plan that has already been sequentially tested, unless the use of the site being proposed is not in accordance with the allocations in the Local Plan.
- Is for the redevelopment of an existing single residential property.
- Is for a conversion or change of use.

All other proposed developments in Flood Zone 3a and Flood Zone 2 will only be considered if there has been a Sequential Test applied in accordance with the NPPF and accompanying PPG. In addition, all development proposals will still need to follow a sequential approach for the final layout and design of the development where possible. The Exception Test will also have to be applied where applicable.

6.2.2 Town Centres

There are five designated town centres in the borough, they are:

- East Sheen
- Richmond
- Teddington
- Twickenham
- Whitton

These town centres are part of the London Plan's Town Centre Network due to their community sustaining role and the functions that they serve. Richmond is categorised as a 'major' centre, whereas the other four are categorised as 'district' centres. Each of these town centres play an important role

as they provide housing, shops, services and employment opportunities. They are also recognised for their transport links.

As outlined in *Section 6.2.1*, development proposals either within town centres or their 800m buffer zones may be subject to the local Sequential Test approach. See *Section 6.2.1* on how to apply the local Sequential Test approach.

6.2.3 Local Centres

There are seven designated local centres in the borough, they are:

- Barnes
- East Twickenham
- Ham Parade
- Hampton Hill
- Hampton Village
- Kew Gardens
- St Margarets

Local centres are areas of mixed use. They serve a similar function to the defined town centres but on a localised level as they provide a focus for communities and opportunities to meet, shop, work and spend leisure time. These areas are primarily used by the local community, whereas town centres are typically used by the wider community.

As outlined in *Section 6.2.1*, development proposals either within local centres or their 800m buffer zones may be subject to the local Sequential Test approach. See *Section 6.2.1* on how to apply the local Sequential Test approach.

6.2.4 Islands

Ten sets of islands are under the administration of the London Borough of Richmond upon Thames. These islands are:

- Ash Island
- Brentford Ait (pair of islands)
- Corporation Island
- Eel Pie Island
- Glover's Island
- Platt's Eyot
- Swan Island
- Taggs Island
- Teddington Lock (pair of islands)
- Trowlock Island

Several of these islands are developed and serve both residents and visitors of Richmond. All these islands are entirely within Flood Zone 2, and a large proportion of their total area coverage is within Flood Zone 3a and Flood Zone 3b. LP 21 of the Local Plan currently states that "where the access and egress to and from the island is within the functional floodplain, for the purposes of new development, such islands will be considered and treated as functional floodplain (Zone 3b), even if parts of the islands may be within an area of lower probability of flooding."

Due to local and national policy, an increase in more vulnerable developments is not permitted on any of the islands. New developments are restricted to 'Water Compatible' and 'Essential Infrastructure' (subject to an Exception Test) as per the guidance in the Flood Risk and Coastal Change PPG. Redevelopment of a building on a like for like basis is permitted. Building redevelopment must ensure that there is no increase in the number of people at risk, therefore the number of dwellings cannot be increased if redevelopment required a building to be knocked down and another one built in its place. Redevelopment requires betterment to mitigate against flood risk, protecting the building and its users from potential flooding. See *Table 6-1* for development requirements.

'Water Compatible' and 'Essential Infrastructure' developments are permitted on the islands as per application of the Sequential and Exception Tests where required. See *Table 6-1* and *Section 6.3* for further information.

6.3 Developers and Applicants

This sub-section provides applicant and developer-specific guidance on the key flood risk management requirements for planning applications. The guidance provides information to ensure that development proposals are compliant.

6.3.1 Application of the Sequential and Exception Tests

Implementation of a sequential, risk-based approach is vital in determining the suitability of a site for development with regards to flood risk. For proposed development sites that require the application of the Sequential Test, and in some instances, the Exception Test, this SFRA document and the accompanying Web Maps provide the basis for applying these tests at a site-specific level.

Proposed development sites within multiple flood risk zones are classed under the highest Flood Zone present on site. For example, a site that partly falls within Flood Zone 1 and Flood Zone 2 is formally classified as a site in Flood Zone 2. The Flood Zone that each proposed site falls under helps inform the approach needed for the site and the information required for the planning application. The Sequential Test will need to be applied to steer the entire proposed site to the areas with the lowest risk of flooding. If the Exception Test is required, the application is based on the highest Flood Zone the site is in and will need to be passed for the planning application.

Sequential Test

The Sequential Test ensures that a sequential approach is followed to steer new development to areas with the lowest probability of flooding. For sites that require it, but have not undergone Sequential Testing as part of the site allocations identified in the London Borough of Richmond upon Thames' Local Plan, a site-specific Sequential Test is required. The search area and definition of reasonable available alternative sites must be determined in line with the guidance below in consultation with the LPA. The scope is not limited to, but should include the following, and any scope should be shared with the LPA for review and agreement prior to the Test being undertaken.

- **Search area:** The default area should be the entire borough. This can be reduced where justified by the functional requirements of the development or relevant objectives of the Local Plan. Examples of these include:
  - Functional requirements – Industrial or infrastructure developments that may service an area wider than the borough.
  - Local Plan objectives – Regeneration of a specific area may be targeted based on objectives set in the Local Plan.

  A local Sequential Test approach is in place for development proposals in town centres, local centres, and areas that fall within the 800m buffer boundary for each centre. See *Section 6.2* for information on how to apply this approach.

- **Reasonable available sites:** These generally include sites that are suitable (those that can accommodate the requirements of the proposed development), developable and deliverable. Sources of where these could be selected from include the following:
  - List of sites prepared as part of the evidence base or background documents produced to inform the Local Plan, such as the London Borough of Richmond upon Thames' Monitoring Report and five year housing land supply.
  - Sites listed under a Local Authority's brownfield land register, which contains information on previously developed sites that are considered to be appropriate for residential development. This includes sites with and without planning permission.

Exception Test

Following the application of the Sequential Test, if it is determined that the proposed development cannot be located in an area with a lower probability of flooding, the Exception Test should be applied. The Exception Test is designed to help ensure that flood risk to both people and property will be managed across the lifetime of the proposed development. To pass the Exception Test, the PPG sets out two considerations that need to be achieved. Both considerations will need to be satisfactorily demonstrated to the LPA for development to be allocated or permitted. These considerations are:

- The development provides wider sustainability benefits to the community that outweigh flood risk, informed by a SFRA where one has been prepared; and
- A site-specific FRA 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.

To satisfy the Exception Test, evidence demonstrating the development proposal's sustainability benefits should be provided. The evidence should demonstrate the wider sustainability benefits that the development would bring at that specific site. This may include evidence demonstrating how the proposed development meets the objectives set out in the Sustainability Appraisal of the Local Plan, or evidence demonstrating policy compliance regarding affordable housing or defined housing needs for the area. In addition, the planning and design of the development needs to demonstrate that the site will remain safe and operational during a flood event. This may involve:

- Designing buildings to avoid flooding by, for example, raising floor levels.
- Implementing resilient and / or resistant features to reduce the impact of a flood. For example, resilient features, such as installing electrical equipment above flood levels, are designed to ensure the internal elements of a property can be recovered as quickly and as cost effectively as possible. Flood resistant features, such as installing flood doors and barriers, are designed to ensure water stays out of a property up to a given height.
- Utilising SuDS as a priority.
- Mitigating the potential impacts of flooding through design and applying a sequential approach on the development site (for example ensuring more vulnerable development lies in less at-risk parts of a site) and flood resilient and resistant construction.
- Developing emergency evacuation procedures. Flood warnings and / or flood alerts (these areas are included in the *Web Map*) need to be considered along with the emergency evacuation procedures in the design and layout of the proposed development.
- Leaving space in developments for flood risk management infrastructure to be maintained and enhanced.
- Providing adequate flood risk management infrastructure which will be maintained for the lifetime of the development.

The PPG Flood Risk Vulnerability and Flood Zone Compatibility table sets out some circumstances where the Exception Test will need to be applied following the Sequential Test.

Application Exceptions

Paragraph 164 of the 2019 NPPF highlights planning application exceptions to Sequential and Exception Tests. Minor developments and change of use development proposals that fall under one of the following criteria should not be subject to the Sequential and Exception Tests:

- Householder developments within the curtilage of the existing dwelling.
- Small non-residential extensions (with a footprint of less than 250m^2).

- Change of use developments – except for changes of use to a caravan, camping or chalet site, or to a mobile home or park home site.

Development proposals that fall under one of these criterion should still meet the requirements for site-specific FRAs as set out in this SFRA and in the NPPF and the accompanying PPG.

6.3.2 Site-Specific Flood Risk Assessment (FRA)

Site-specific FRAs should be proportionate to the degree of flood risk, making the best use of available information. They should also be appropriate to the scale, nature and location of the development. For example, developments such as single house extensions would generally require a less detailed assessment as they tend not to significantly increase the number of people present in an area at risk of flooding. Conversely, new developments comprising of multiple houses in a similar location would generally require FRAs with greater detail. For further information, see the 'Site-specific FRA' key requirement section in *Table 6-1* and the EA's guidance on FRAs for Planning Applications.

The site-specific FRA requires potential flood depths to be addressed as part of flood risk management and emergency planning measures where there is a probability of flooding from any flood risk source. Depending on the circumstances, certain mitigation measures will need to be employed to demonstrate that the potential impacts of flood depth will be adequately addressed. The most appropriate measure depends on a range of different factors including flood risk source, the potential impact of the flood risk, and the vulnerability classification of the development amongst others.

Where major and minor developments are proposed within the 1 in 100 year surface water extent (based on the Surface Water Flood Risk Web Map), the London Borough of Richmond upon Thames requires the developer and/or applicant to submit a FRA. Change of use developments that fall within the 1 in 100 year extent and have a bearing on a site's existing drainage regime, e.g. change of use developments as part of a landscaping proposal, also require an FRA.

For further guidance on the preparation and development of a site-specific FRA, the PPG has a checklist to provide guidance through the process. The London Borough of Richmond upon Thames has a 'Guidance on Producing a Flood Emergency Plan' document which provides detailed information on producing a flood emergency plan for planning applications that require one. Further details on the requirements of emergency planning can be found in *Table 6-1*.

6.3.3 Statement on SuDS

As part of, or separate to, site-specific FRAs, information demonstrating how surface water runoff generated by the development site will be managed may need to be presented. As FRAs are not required for all developments, producing a separate Statement on SuDS may be advisable. A Statement on SuDS is a report that demonstrates how surface water could affect a site of interest and the surrounding areas post-development. The statement should include the proposed SuDS features which are to be incorporated in the development (to improve the existing runoff conditions), along with details for their long-term management and maintenance. A statement is required for all major developments. This includes sites identified as being at risk of surface water flooding, and those that have a history of surface water flooding. All minor developments and developments categorised as 'change of use' which modify existing surface water drainage will also require a Statement on SuDS. For example, if a minor development or development categorised as a 'change of use' proposes to amend the landscaping, a Statement on SuDS is required. Taking climate change into account, the statement needs to demonstrate how water is expected to behave on a site, determine the site's

infiltration potential, runoff rates, and flow pathways, both before and after the proposed development is in place. Submitted information needs to also demonstrate that the proposed development will not increase flood risk to the surrounding sites.

The London Borough of Richmond upon Thames has collaborated with the London Drainage Engineers Group (LoDEG) and other London Boroughs to produce a Sustainable Drainage Proforma. All major development proposals, and proposals that have been identified as requiring a Statement on SuDS, need to complete the Excel version of the Proforma.

Further details on the SuDS requirements and SuDS implementation to address the impact of future growth are contained in *Section 6.1* (*Table 6-1*) and *Section 7.2* respectively.

6.3.4 Sustainable Drainage Systems (SuDS)

SuDS incorporate a range of measures and management techniques designed to manage surface water runoff. All new developments should incorporate SuDS in line with the Non-Statutory Technical Standards for Sustainable Drainage Systems. Policy LP 21 of the London Borough of Richmond upon Thames' Local Plan requires the use of SuDS in all development proposals.

The SuDS measures should aim to achieve greenfield runoff rates, providing management and attenuation features that ensure that surface water runoff is managed as close to the source as possible. Greenfield runoff conditions must be achieved for any greenfield sites. Development on current brownfield sites should also aim to achieve greenfield runoff rates where practical. Several policy and guidance documents provide information to assist with the implementation of SuDS. In addition to the London Plan, the LSDAP, and CIRIA guidance documents The SuDS Manual and Guidance on the Construction of SuDS provide important information. Richmond upon Thames has produced a Delivering SuDS in Richmond guidance document to assist developers and prospective applicants on incorporating SuDS as part of their development proposals.

Applications need to outline the SuDS measures that the proposed development will include and demonstrate how they will connect with any piped drainage system if infiltration is not possible. The submitted evidence needs to demonstrate that the current London Plan drainage hierarchy (in line with Policy SI13 Sustainable drainage) has been followed. Surface water management features higher up the drainage hierarchy should preferably be incorporated:

1. rainwater use as a resource (for example rainwater harvesting, blue roofs for irrigation)
2. rainwater infiltration to ground at or close to source
3. rainwater attenuation in green infrastructure features for gradual release (for example green roofs, rain gardens)
4. rainwater discharge direct to a watercourse (unless not appropriate)
5. controlled rainwater discharge to a surface water sewer or drain
6. controlled rainwater discharge to a combined sewer

Where information is available, the Groundwater, Sewer and Artificial Flood Risk Web Map, SWMP main report and SWMP Appendix D indicates where infiltration based SuDS may be potentially suitable for use, where uncertainties exist and where they are unlikely to be suitable. Where infiltration SuDS are potentially suitable or uncertain, the developer and/or applicant must provide site-specific infiltration testing or borehole data to justify use of non-infiltration-based surface water management techniques within their Statement on SuDS.

Not all developments that require a planning application have a bearing on a site's existing drainage regime, or the potential to impact flood risk locally. This may include certain minor developments that do not increase the built footprint of a site, do not introduce new building structures, and/or do not alter associated landscaping. However, this needs to be demonstrated in line with Policy SI 13 of the current London Plan and Policy LP 21 of the London Borough of Richmond upon Thames' Local Plan which require developments to demonstrate that the surface water discharge rate from the site is at the greenfield runoff rate. If this is not achievable, proposals need to demonstrate a betterment of the current rate. Developers and applicants are therefore required to demonstrate that runoff rates are at least no more than three times the calculated greenfield rate and that the development can achieve at least a 50% attenuation of the site's surface water runoff at peak times.

Some of these cases may not present an opportunity to improve on-site water management. However, efforts should be made to improve the site's drainage systems as the current regime may have wider flood risk implications for the area. For further information, contact the LLFA. Further details on SuDS is provided in *Table 6-1*.

6.4 Local Planning Authority – Development Management

This sub-section provides Development Management-specific guidance to ensure that the key requirements for individual planning applications can be effectively evaluated and assessed. Development should be considered at a strategic level, so it is important to identify how individual development proposals fit within a wider flood risk management strategy for a given area. The guidance accompanies the information presented in the tables in *Section 6.1*.

6.4.1 Application of the Sequential and Exception Tests

Implementation of a sequential, risk-based approach is vital in determining the suitability of a site for development with regards to flood risk. Developers and applicants need to provide evidence to demonstrate that the Sequential Test, and in some instances, the Exception Test has been applied for any proposed development site that requires them. It is then for the LPA to consider the extent to which the Sequential Test and Exception Test considerations have been satisfied, taking into account the particular circumstances in any given case. This SFRA document, and the Web Maps, provide the basis for applying these tests at a site-specific level.

Guidance on development in London, and the types of sites and locations to be considered, has seen a push towards certain considerations. The current London Plan (2021) identifies small site developments making an important contribution towards meeting housing objectives (Policy H2 'Small sites'). In addition, the need to adopt a sequential approach to guide development for main town centres is also of importance. This is in line with Policy SD7 'Town centres: development principles and Development Plan Documents'. These are important considerations for boroughs when considering new development proposals.

The PPG contains information on development compatibility within different Flood Zones. This table works in conjunction with the PPG Flood Risk Vulnerability Classifications table to provide guidance on the types of development that may be considered as suitable within Flood Zones.

Sequential Test

The Sequential Test uses a sequential approach to steer new development to areas with the lowest probability of flooding. This means that certain development proposals should not be permitted in high and medium flood risk areas, where there are reasonably available sites appropriate for the

proposed development in areas of lower flood risk. Within each Flood Zone, all sources of flooding need to be considered when applying this risk-based approach to the proposed development site.

For sites that have not undergone Sequential Testing as part of the development of the Local Plan (e.g. site allocations), but require it, developers and applicants will need to complete a site-specific Sequential Test and provide evidence that the Test has been undertaken as part of the planning application. For information on the Sequential Test search area and definition of reasonable available sites, see *Section 6.3.1*.

Exception Test

Developers and applicants may need to provide evidence that the Exception Test has been applied if the Sequential Test demonstrates that the proposed development cannot be located in an area at lower flood risk. Through the Exception Test, the developer and/or applicant needs to demonstrate that flood risk to both people and property will be managed across the lifetime of the proposed development. Developers and/or applicants should also ensure that climate change factors are taken into consideration over the development's lifetime. The PPG sets out two considerations that need to be achieved in order to pass the Exception Test. Both considerations need to be satisfactorily demonstrated by the developer and/or applicant before development can be allocated or permitted. These considerations are:

- The development provides wider sustainability benefits to the community that outweigh flood risk, informed by a SFRA where one has been prepared; and
- A site-specific FRA 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.

The PPG Flood Risk Vulnerability and Flood Zone Compatibility table sets out some circumstances for Exception Test application following Sequential Testing. Evidence of Exception Testing may need to be applied for particular developments within areas subject to redevelopment or regeneration. For developments that are part of regeneration strategies, it is likely that they will provide the wider sustainability benefits required to pass that aspect of the Exception Test. All submitted planning applications still need to demonstrate that the development will be safe for its lifetime, will not increase flood risk elsewhere and, where possible, will reduce flood risk overall. For information on how the second consideration of the Exception Test could be achieved by the developer and/or applicant, see *Section 6.3.1*.

6.4.2 Site-Specific Flood Risk Assessment (FRA)

Submitted site-specific FRAs should demonstrate how flood risk will be managed now and in the future over the proposed development's lifetime. The FRA needs to take climate change into account, and the vulnerability of land use classification of the development (Refer to Table 2 – Flood Risk Vulnerability of the PPG). An FRA should be provided with a planning application for developments in the following circumstances:

- All development proposals in Flood Zone 3, including minor development and change of use *[– Note minor developments include property sub-division (as this is 'development' defined by Section 55 of the Town and Country Planning Act 1990) and extensions that exceed the parameters of Permitted Development defined by Planning Portal Guidance]*.
- All development proposals in Flood Zone 2 (in line with Policy LP 21 'Flood Risk and Sustainable Drainage' of the London Borough of Richmond upon Thames' Local Plan).
- Proposals for development areas that are 1 hectare or greater in Flood Zone 1.

- New proposals, or a change of use in development type to a more vulnerable class, where the proposed development could be affected by sources of flooding other than rivers and the sea.
- Proposals within areas with critical drainage problems as designated by the EA *[- – Note that this does not include Critical Drainage Areas as defined by the London Borough of Richmond upon Thames' SWMP – there are currently no such areas defined by the EA within the borough at the time of publication of this SFRA in March 2021].*
- The London Borough of Richmond upon Thames has set the 1 in 100 year surface water flood risk map extent as a trigger for FRAs. Major and minor development proposals within this extent (based on the *Surface Water Flood Risk Web Map*), are required to submit an FRA. Change of use developments that fall within this 1 in 100 year extent and have a bearing on a site's existing drainage regime are also required to submit an FRA. This includes change of use developments applications that feature proposals which make changes to the existing landscaping.

As early as possible, Development Management should refer this SFRA and the accompanying Web Maps to developers and applicants, highlighting the key areas that could impact their proposals. For development proposals in areas at risk of fluvial or tidal flooding, there is a statutory requirement for LPAs to consult the EA before planning permission is granted under the Town and Country Planning (Development Management Procedure) (England) Order 2015. For advice on when the EA should be consulted, and guidance for where fluvial / tidal flood risk is an issue, the EA has developed Standing Advice. The PPG has a checklist which can aid in the process of reviewing a site-specific FRA.

6.4.3 Statement on SuDS

Developers and applicants may need to demonstrate how surface water runoff generated by the development site will be managed. This may be demonstrated through a Statement on SuDS, a report that should demonstrate how surface water could affect a site of interest and the surrounding areas. A strategy is required for all major developments not categorised as 'change of use'. All minor developments and developments categorised as 'change of use' which modify existing surface water drainage will also require a Statement on SuDS.

All major development proposals that have been identified as requiring a Statement on SuDS need to provide a completed London Borough of Richmond upon Thames Sustainable Drainage Proforma as per the Local Validation Checklist for All Applicants. The Proforma has been divided into four sections which require developers and applicants to demonstrate the following:

- Site and project information – Details of the proposed development, existing site and drainage system.
- Proposed discharge arrangement – Details regarding the infiltration feasibility for potential infiltration and the proposed surface water discharge method. The drainage hierarchy, which must be referred to, presented in the Sustainable Drainage Proforma is currently based on Policy SI 13 of the current London Plan and Policy 5.13 of the 2016 London Plan.
- Statement on SuDS – Details of the greenfield, brownfield (where relevant) and proposed discharge rates. Information regarding the proposed SuDS measures, along with their proposed catchment areas and storage capacities are also required.
- Supporting information – Details regarding the evidence and supporting information for the information provided in the Proforma, including proposed maintenance approaches.

DEFRA published the Non-Statutory Technical Standards for Sustainable Drainage Systems in March 2015. The document's Standards, which an application should refer to, include:

- Flood risk outside the development
- Peak flow control
- Volume control

- Flood risk within the development
- Structural integrity
- Construction
- Designing for maintenance considerations

These Standards should be used for the assessment of Statements on SuDS and the accompanying Sustainable Drainage Proformas submitted with planning applications.

6.4.4 Sustainable Drainage Systems (SuDS)

SuDS incorporate a range of measures and management techniques designed to manage surface water runoff. They should mimic natural drainage approaches as closely as possible, providing an alternative to 'hard engineered' traditional drainage. They provide opportunities to:

- Reduce the causes and impacts of flooding, providing opportunities to reduce the overall local flood risk through the limiting of surface water runoff rates and, where possible, volumes.
- Minimise pollution from urban runoff at source.
- Enable groundwater recharge where infiltration is possible.
- Combine water management with green space, providing environmental, amenity and recreational benefits.

Local Plan Policy LP 21 (Flood Risk and Sustainable Drainage) is a key policy for flood risk and water resource management. The policy requires developers and applicants to follow the drainage hierarchy as laid out in Policy 5.13 of the 2016 London Plan. The purpose of the drainage hierarchy is to ensure that reasonable measures are taken to sustainably manage and reduce the amount of rainfall being discharged from a development site. Developers and applicants should take measures to ensure that surface water management features higher up the drainage hierarchy are incorporated. Where measures higher up the hierarchy have not been proposed, justification should be provided to demonstrate why it is not possible to implement certain features. The drainage hierarchy is as follows:

1. store rainwater for later use
2. use infiltration techniques, such as porous surfaces in non-clay areas
3. attenuate rainwater in ponds or open water features for gradual release to a watercourse
4. attenuate rainwater by storing in tanks or sealed water features for gradual release to a watercourse
5. discharge rainwater direct to a watercourse
6. discharge rainwater to a surface water drain
7. discharge rainwater to a combined sewer

Policy SI13 (Sustainable drainage) of the current London Plan (2021) presents an updated drainage hierarchy which highlights the policy's objective of prioritising green surface water management features over grey ones. The current London Plan drainage hierarchy is as follows:

1. rainwater use as a resource (for example rainwater harvesting, blue roofs for irrigation)
2. rainwater infiltration to ground at or close to source
3. rainwater attenuation in green infrastructure features for gradual release (for example green roofs, rain gardens)
4. rainwater discharge direct to a watercourse (unless not appropriate)
5. controlled rainwater discharge to a surface water sewer or drain
6. controlled rainwater discharge to a combined sewer

Applicants should aim to reduce surface water discharge in line with the current Sustainable Drainage Hierarchy as set out in Policy SI 13. Measures should also be taken to prioritise green surface water management features over grey ones.

Developers and applicants should aim to achieve greenfield runoff rates via their proposed SuDS measures and ensure that surface water runoff is managed as close to the source as possible. The proposed measures should be incorporated in line with the Non-Statutory Technical Standards for Sustainable Drainage Systems.

In April 2015, LLFAs became statutory consultees on major planning applications with surface water drainage implications. The associated Written Ministerial Statement HCWS161, alongside the London Plan, demonstrate the importance of developers and applicants incorporating SuDS into their development proposals. This means that LPAs are required to consult LLFAs for expertise and technical advice on the management of surface water before reaching a decision on major planning applications under the Town and Country Planning (Development Management Procedure) (England) Order 2015.

The issues that are analysed by LLFAs and LPAs for planning applications are referred to as 'material planning considerations', issues that are relevant to the decision making process. As stated in the Written Ministerial Statement HCWS161, SuDS are a material planning consideration for all major applications, and decisions on all planning applications require evidence that SuDS are implemented to ensure surface water is managed safely and sustainably on site. Further information on material planning considerations, planning applications and the decision making process can be found on the Determining a Planning Application guidance page.

6.5 Planning Policy

6.5.1 Application of the Sequential and Exception Tests

The NPPF highlights the need for a sequential, risk-based approach to be considered for development. This approach aims to keep development out of Flood Zones 2 and 3, and areas at risk from other sources of flooding, where possible. Implementation of this approach requires proposed development sites to be reviewed through the application of the Sequential Test, and in some instances, the Exception Test. This SFRA document, and the Web Maps, provide the basis for applying these tests, at the site-specific level.

Strategic application of the Tests for allocated sites, if required, are generally completed as part of the Local Plan development process by LPA officers (in consultation with the EA). This process should be informed by the initial screening assessment completed for current allocated sites. Recommendations for completing Level 2 SFRAs are made in *Section 7* where further flood risk information and assessment may be required to inform the Tests. Guidance is provided in the following sections for application of the Tests at the Local Plan / strategic scale.

Sequential Test

The Sequential Test ensures that a sequential approach is followed to steer new development to areas with the lowest probability of flooding. This document provides the evidence base for the Sequential Test to be applied at a borough-wide or local level in preparation for a borough's Local Plan and associated allocated sites, depending on where the site is located.

If the application of the Sequential Test demonstrates that development can be allocated in Flood Zone 1, the developer and applicant will have passed the Sequential Test once the proposed development has been moved to a site in Flood Zone 1. However, some areas at lower flood risk may not be suitable for development due to various other reasons. In these instances, the Sequential Test should be applied to guide the development to the lowest risk area appropriate for the development type. This increases the possibility of facilitating development which is at the lowest risk of flooding in line with

the relevant vulnerability of land use classification. The PPG flowchart demonstrating the 'Application of the Sequential Test for Local Plan Preparation' provides guidance.

Policy LP 21 of the London Borough of Richmond upon Thames' Local Plan goes beyond the Sequential Test requirements as described in the PPG. The approach impacts town centres, local centres, and areas that fall within the 800m buffer boundary for each centre. This information, and further local Sequential Test requirements, is listed in *Section 6.2*.

The following process is recommended for the LPA to complete the Sequential Test for site allocations during Local Plan development based on the PPG's development vulnerability classification. Application of the process below is also dependent on the local Sequential Test approach (see *Section 6.2* for further information):

1. Complete a screening assessment of all sites to identify flood risk sources and how they might be impacted by climate change. The Web Maps should be used to identify flooding from all sources as detailed in *Section 5*. The potential impacts of climate change for each assessed flood risk source is also provided. Risk assessment specific guidance for the application of climate change is provided in *Section 4*.
2. Assess how long it is anticipated each development will be present for (the 'design life'). A design life of 100 years for residential development and 60 years for non-residential development is recommended if no other information is available.
3. Any 'Highly Vulnerable' developments should be located within Flood Zone 1. If this is not possible due to a lack of suitable sites, then locations in Flood Zone 2 can be considered where the Exception Test can be passed. If no suitable sites exist in Flood Zones 1 or 2, then further opportunities for development locations should be sought (this could be within or outside the borough)
4. A similar process can then be applied to 'More Vulnerable' developments with priority given to locations within Flood Zones 1 and 2. If there are no suitable sites, then Flood Zone 3a can be considered where the Exception Test can be passed.
5. 'Less Vulnerable' developments can then be located within remaining sites in Flood Zones 1, 2 and 3a (in that order of preference). This development classification is not appropriate for Flood Zone 3b.
6. 'Essential Infrastructure' should also be preferentially located in the lowest risk Flood Zone available for the type of infrastructure. This development can be located in Flood Zone 3a or 3b after passing the Exception Test.
7. 'Water Compatible' development should be allocated last as they generally have the fewest constraints with regards to flood risk.

Where proposed site allocations are at a risk of flooding from one or more sources, Level 2 SFRA recommendations are made in *Section 7* for specific allocated sites. The Level 2 SFRA can provide site-specific flood risk management recommendations and an assessment of whether the site could pass the Exception Test on this basis.

Exception Test

The Exception Test should be applied after the Sequential Test if it has been determined that a proposed development cannot be located in an area with a lower flood risk. To pass the Exception Test and ensure that flood risk to both people and property is effectively managed across the proposed development's lifetime, the PPG sets out two considerations that need to be achieved. These considerations are:

- The development provides wider sustainability benefits to the community that outweigh flood risk, informed by a SFRA where one has been prepared; and
- A site-specific FRA 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.

The PPG's 'Application of the Exception Test for Local Plan Preparation' flowchart provides guidance on applying the Exception Test for Local Plans. The flowchart highlights that following the borough-wide level Sequential Test, the Exception Test will need to be applied if certain development sites are not in an appropriate location. Guidance for what is deemed an appropriate location is based on NPPF flood risk policy as highlighted in *Section 2.2.1*. A Level 2 SFRA may also be used to assess allocated sites in more detail to determine if the Exception Test can be passed. Recommendations for Level 2 SFRA assessments are made in *Section 7*.

6.6 Emergency Planning

Under the Civil Contingencies Act 2004, the London Borough of Richmond upon Thames is designated as a Category 1 Responder. They are required to assess risks and respond appropriately in case of an emergency. This includes responding to a major flooding event. The London Borough of Richmond upon Thames' responsibilities under the Act are:

a) from time to time assess the risk of an emergency occurring;
b) from time to time assess the risk of an emergency making it necessary or expedient for the person or body to perform any of his or its functions;
c) maintain plans for the purpose of ensuring, so far as is reasonably practicable, that if an emergency occurs the person or body is able to continue to perform his or its functions;
d) maintain plans for the purpose of ensuring that if an emergency occurs or is likely to occur the person or body is able to perform his or its functions so far as necessary or desirable for the purpose of:
    i. preventing the emergency,
    ii. reducing, controlling or mitigating its effects, or
    iii. taking other action in connection with it

Section 5 of this SFRA and the accompanying Web Maps should be used to help the London Borough of Richmond upon Thames' Emergency Planning Unit to help inform response requirements in line with the Civil Contingencies Act 2004. Emergency planning can use the information to tailor needs to be area and risk specific.

7 RECOMMENDATIONS

7.1 Overview

Climate change is widely identified as the biggest factor which may increase the risk of flooding across the UK. Several key drivers, including development and urban expansion, could see an increase in flood risk from various sources. For example, a decrease in permeable ground cover due to urban development may increase the risk of surface water flooding.

The demand for more housing may mean a larger number of developments being proposed for sites within higher risk Flood Zones, placing them at greater risk of flooding. The combined impact of climate change, development requirements and projected future population growth may have an impact on the flood risk presented by different flood sources. In addition, it may present a greater overall flood risk to people and properties due to the accumulative risk from different flood sources. To meet flood risk mitigation requirements whilst facilitating housing development needs, local policy targeting the impact of future growth on flood risk is required.

The NPPF and accompanying PPG state that a sequential, risk-based approach to the location of development should be applied. This would enable possible flood risk to people and property to be avoided whilst taking impacts of climate change into account. This underpins the policy and site-specific recommendations for the borough. For further information, see *Section 7.7*.

7.2 The Impact of Future Growth on Flood Risk

The current London Plan (2021) sets out ten-year housing targets (from 2019/20 to 2028/29) to help meet the demands presented by future growth. This housing target is set in line with Policy H1 '*Increasing housing supply*' which provides actions and requirements to ensure that boroughs meet their ten-year target. These targets are based on the 2017 London Strategic Housing Land Availability Assessment.

The ten-year target set for the London Borough of Richmond upon Thames in the current London Plan is to deliver 4,110 new homes. Delivery of a number of those houses through small sites (sites below 0.25 hectares in size) is a strategic priority. This is in line with Policy H2 '*Small sites*' which provides guidance for LPAs on what they should do to support small site housing developments. Of the 4,110 new homes target set for Richmond upon Thames, 2,340 of those should be delivered on small sites.

The London Plan also identifies several other site types to be targeted for housing delivery. This includes Opportunity Areas for a range of available brownfield sites. The current London Plan highlights Opportunity Area Planning Frameworks as the means to develop policies and supporting documentation required to develop a plan-led approach and provide the required infrastructure. There are currently no Opportunity Areas identified within the London Borough of Richmond upon Thames.

The London Plan recognises that London is at particular risk from surface water flooding, largely due to the extent of impermeable surface coverage in the city. The projected housing targets for the ten-year period could further exacerbate surface water flood risk by introducing even more impermeable surfaces. Policy SI5 '*Water infrastructure*', Policy SI12 '*Flood risk management*', and Policy SI13 '*Sustainable drainage*' all set out requirements to mitigate and manage flood risk in recognition of the pressing need for more housing.

The NPPF and PPG recognise the impact of increasing development on flood risk throughout the country. They require that all developments need to demonstrate that they will remain safe for their lifetime without increasing flood risk elsewhere. The PPG defines the lifetime of residential developments as a

minimum of 100 years unless reasons are stated otherwise. The lifetime of a non-residential development is locally defined as 60 years minimum. Information must be presented if developers and applicants believe the individual characteristics of a proposed non-residential development means the lifetime should be something else. With the impact that an increasing number of properties could have on flood risk, it is vital that developments demonstrate that flood risk is not increased, but that flood risk is reduced overall wherever possible. To achieve these objectives, and those listed as part of the policies and guidance in *Section 2*, it is vital to ensure that the impact of future growth on flood risk is mitigated as much as possible.

7.3 Groundwater Investigation

In recognising the potential impact that an increasing number of properties could have on flood risk, a borough-wide investigation on potential groundwater related flooding was carried out. The initial investigation was triggered due to concerns of elevated levels of basement and/or cellar flooding from groundwater related sources. New subsurface developments were identified as a potential factor in elevating potential flood risk. The initial investigation identified that basement and cellar substructures in the Richmond Hill area of the borough may be at risk of groundwater influenced flooding via throughflow. Groundwater travels downhill through the aquifers/permeable superficial deposits from the top of the catchment. If there are no aquifers/permeable superficial deposits for water to flow through, water continues to flow through the interface of the made ground subsurface level and the clay geology stratum. This is referred to as throughflow.

The '*Further Groundwater Investigations*' project (2020) sought to identify other catchment areas with similar geological and topographical characteristics to Richmond Hill. Catchments were also identified based on the presence of properties in the downstream extent of the catchment, and if they therefore may possess subsurface structures that could be at risk of flooding via throughflow. In addition to Richmond Hill, the investigation identified three further catchment areas (Strawberry Hill (Twickenham), Marble Hill (Twickenham) and St. Margarets West) as being at increased flood risk caused by throughflow mechanisms, which categorises them as 'throughflow catchment areas'. A further catchment area (East Sheen Common) was identified as a 'potential throughflow catchment area', possessing most of the characteristics that the other catchment areas have. However, this catchment is underlain with unproductive and/or low permeable geology in a different area to the building developments, which differentiates it from the designated 'throughflow catchment areas'.

Measures may be required to ensure that proposed subsurface developments do not increase the risk of throughflow and groundwater related flood risk in the immediate area. The *Basement Assessment User Guide* and the *Further Groundwater Investigations* (2020, with minor updates 2021) Report provides details of questions which should be addressed as part of the Basement Screening Assessment for proposed developments within the 'throughflow catchment areas'. They also provide guidance on the basement assessment process. See *Section 7.7* for the recommended policies following the *Further Groundwater Investigations*' (2020 with minor updates 2021) study.

7.4 Property Level Resilience Measures

The NPPF requires that policies support appropriate measures to ensure the future resilience of communities and infrastructure against climate change impacts. This includes ensuring that developments are appropriately flood resistant and resilient. The PPG defines flood resilience developments as buildings designed and constructed to reduce the impact of flood water entering the building so that no permanent damage is caused. They are designed in a way to ensure that their structural

integrity is maintained, and to ensure drying and cleaning is easier. To assist prospective applicants, developers and designers, MHCLG published Improving the Flood Performance of New Buildings: flood resilient construction (2007). It provides guidance on how to improve the resilience of new properties against different flood risk sources. Details of flood resistance and resilience plans need to be provided as part of the FRA and / or Statement on SuDS submitted as part of the planning application.

Policy D11 of the London Plan highlights requirements for '*Safety, security and resilience to emergency*'. The policy requires that "*Development proposals should maximise building resilience and minimise potential physical risks, including those arising as a result of extreme weather, fire, flood and related hazards*". The London Plan also lays out Policy GG6 '*Increasing efficiency and resilience*' which states that those involved in planning and development must "*ensure buildings and infrastructure are designed to adapt to a changing climate, making efficient use of water, reducing impacts from natural hazards like flooding and heatwaves, while mitigating and avoiding contributing to the urban heat island effect.*"

The London Borough of Richmond upon Thames has identified the importance of ensuring that development is resilient through their 2018 Local Plan. In line with the Local Plan's objectives for a 'Sustainable Future', Policy LP 20 is around 'Climate Change Adaptation'. The policy states that:

"*The Council will promote and encourage development to be fully resilient to the future impacts of climate change in order to minimise vulnerability of people and property.*"

This includes ensuring that new developments are resilient against wetter winters, increases in rainfall, increased fluvial and surface water flooding risks, more frequent heavy downpours of rain, and flash floods. The London Borough of Richmond upon Thames requires development proposals to include flood resilient and resistant measures to be incorporated into development designs. If proposed development is categorised as a 'minor extension' or a 'vulnerable development', please see the EA Flood Risk Standing Advice information for minor extensions and vulnerable developments respectively. These sections provide additional guidance on appropriate property resistance and resilience measures.

7.5 Emergency Plans

Emergency planning is vital to ensure the potential impact of flooding within the London Borough of Richmond upon Thames is minimised. As climate change and urban development increase the risk of flooding, there is a greater need for cohesive emergency planning at strategic and site-specific levels.

Development needs to ensure that it does not impede on the emergency services or the London Borough of Richmond upon Thames' Emergency Planning Unit's response to any flood events. A borough-wide emergency plan can provide policy context on how emergencies, including flood risk, are managed within the borough. This can help define the response structure to emergencies within the borough and provide guidance on deployment and co-ordination. It can also provide further policy context for local Flood Warning and Evacuation Plans. Developers and prospective planning applicants need to ensure that appropriate evacuation and flood response procedures are in place and aligned to the wider strategic plan. This will help the London Borough of Richmond upon Thames to better manage the 'actual' and 'residual' risks associated with an extreme flood event on a strategic and site-specific level.

7.6 Managing Residual Risk

Residual risks are the risks that remain after the effects of mitigating actions have been taken into account. Under current climate conditions, these risks need to be quantified to ensure the remaining risks can and will continue to be safely managed. However, as climate change alters the rainfall occurrence, duration, and intensity, the residual risks from a mitigation measure implemented today could significantly change.

The London Plan (2021) identifies the importance of managing residual risk via Policy SI12 'Flood risk management'. It highlights the importance of strategies mitigating residual risk through resistance and then resilience, ensuring safe evacuation and quick recovery to address such risks are in place. Climate change could increase the severity and impact of flooding, making it challenging for the emergency services to gain access as required. Developments should be designed with the impacts of climate change in mind to ensure that the emergency services continue to have access in extreme events. Considerations also need to be made to, as a residual risk measure, ensure that people can remain within them and be safe and comfortable in the unlikely event of such an extreme flood. As the collective understanding of climate change increases, risks and residual risks may need to be re-evaluated. This will enable the LLFA, management companies and users to implement further control measures in the future as necessary.

7.7 Recommended Policies

7.7.1 Strategic Policies

1. The London Borough of Richmond upon Thames should consider implementing the 1 in 100 year surface water extent as Flood Zone 3a (surface water) for the borough. These requirements of Flood Zone 3a (surface water) could be similar to those adopted for Flood Zone 3a (fluvial / tidal) with modifications as follows:
    a. Development within the 1 in 100 year RoFSW mapped extent will be treated as if it were Flood Zone 3a as defined in PPG Table 1 (Paragraph 065).
    b. Highly vulnerable developments may be possible within the 1 in 100 year RoFSW mapped extents outside of existing infrastructure or solid building footprints.
    c. To enable development, proposals must provide mitigation and resilience against flood risk (taking advice from the LLFA as appropriate) and provide appropriate compensation to existing flood risk levels and volumes (addressing the predicted 1 in 100 year RoFSW mapped depths as a minimum), supported by detailed flood risk modelling if appropriate.
    d. The development must not increase flood risk elsewhere and where possible reduce flood risk overall. Evidence demonstrating that all surface water is managed on site and that surface water is discharged at greenfield runoff rate (or within three times the calculated greenfield rate) is required.
2. The London Borough of Richmond upon Thames should conduct a Level 2 SFRA screening assessment based on the current allocated sites in the borough. This assessment will help inform which sites require a Level 2 SFRA. See *Section 8.2* for further Level 2 SFRA information.
3. The London Borough of Richmond upon Thames should implement measures through their Local Plan to deal with the Sequential Test acceptability of windfall site development (sites which become available for development unexpectedly) proposals at the strategic level. The measure could set out locations and quantities of windfall sites that would or would not be acceptable in Sequential Test terms (to provide input to the process defined in *Section 6.3.1*). This would help create efficiencies in the process.
4. The London Borough of Richmond upon Thames should adopt a Catchment Based Approach to ensure recognition of catchment-wide flood issues to justify the collection and use of S106 funding to investigate and develop flood alleviation schemes within the catchment the development falls in. CDAs defined by the borough SWMP (for surface water flooding) or policy sub-areas defined by EA CFMPs (for fluvial / tidal flooding) provide an established technical basis for this approach.
5. The London Borough of Richmond upon Thames should incorporate the draft London RFRA 2018 recommendations into future Local Plan policies and documents once finalised. This includes

Recommendation 2 (Fluvial Flood Risk) and Recommendation 3 (Surface Water Flood Risk) which provide recommendations in line with Policy SI 12 and Policy SI 13 respectively of the current London Plan. The recommendations are summarised as follows:

a. Recommendation 2 – Planning policies should focus on making the most of the opportunities presented by regeneration and redevelopment on river corridors to reduce fluvial flood risk through location, layout and design of development. Opportunities should also look at flood compatibility, flood resilience and maximising open space for flood water.
b. Recommendation 3 – Developments should reduce surface water discharge in line with the Sustainable Drainage Hierarchy set out in Policy SI 13 of the London Plan, and the actions in the London Sustainable Drainage Action Plan (LSDAP) should also be taken.

6. The London Borough of Richmond upon Thames should make space for water storage by identifying strategic locations that are required for current and future flood risk management. These identified areas of land should be safeguarded via Local Plans to facilitate links between flood risk management and other environmental priorities. The London Borough of Richmond upon Thames should work with the LLFA and EA to identify such potential locations through flood alleviation schemes.
7. The London Borough of Richmond upon Thames should designate the following catchment areas as throughflow and groundwater policy zones as per the '*Further Groundwater Investigations*' (2020, with minor updates in 2021) report:
    a. Richmond Hill (Richmond)
    b. Strawberry Hill (Twickenham)
    c. Marble Hill (Twickenham)
    d. St. Margarets West

Subsurface structure development proposals within these zones need to fulfil site-specific requirements to demonstrate that basements, cellars, and other subsurface structures can be safely developed without increasing throughflow and groundwater related flood risk.

7.7.2 Site-specific Policies

1. The London Borough of Richmond upon Thames should insist that submitted FRAs utilise the 'upper end' climate change scenarios when implementing the climate change allowances for surface water and fluvial flood risk. Fluvial flood risk climate change requirements may need to be updated once EA guidance on how the 'H++' category should be applied to development management decisions has been released. Assessments of tidal flood risk should use the current TE2100 crest levels guidance and breach modelling. This would account for the worst-case scenarios.
2. The London Borough of Richmond upon Thames should ensure where possible that land within development sites are safeguarded for potential flood mitigation use through the active consideration of predicted flood mapping from all sources. This can be done as part of the planning process or as part of wider flood risk assessments such as a Level 2 SFRA.
3. Development proposed in 'dry islands' (areas within Flood Zone 1 that are surrounded by areas at higher risk of flooding, i.e., areas falling within Flood Zone 2 and 3) should be designed for safe access and egress in a flood event. 'Dry islands' are considered as flood risk areas due to the potential loss of important local services during flood events and lack of safe access routes. They require safe access and egress routes to be developed for the lifetime of the property, factoring in the impacts of climate change.

4. The London Borough of Richmond upon Thames should insist that a Screening Assessment is carried out as part of the planning application submission for all basement and cellar proposals within the throughflow and groundwater policy zones. The Screening Assessment should address the impacts of the proposed subsurface development on the area's subterranean characteristics, land stability, and flood risk and drainage. If the Screening Assessment determines that the proposed subsurface development may have an impact on the local environment, or if it determines that further investigation work is required, then a Basement Impact Assessment is required. The impact assessment, undertaken by an appropriate chartered professional or specialist, must include, but is not limited to, the following details:
    a. Detailed borehole information on or from nearby to the development site. At least two data recordings should take place within a period of at least 12 months to demonstrate any potential seasonal variations. These measurements should identify the geological conditions on or close to the development site, the infiltration potential and the height of any groundwater.
    b. Mitigation if the identified potential impacts of the proposed subsurface development are not acceptable. If, for example, the assessment identifies that the proposed development may result in water ingress to the new development and/or to neighbouring properties, then mitigation measures should be proposed to reduce and/or alleviate the risk of flooding.

    To ensure that such development is feasible and will not adversely impact the site, neighbouring properties, or the wider natural environment, such assessments should be completed prior to any planning permission being granted.

8 Review and Next Steps

8.1 Review & Updates

8.1.1 Technical Content

The SFRA has been developed using the most recent policy, legislation and information available at the time of writing (March 2021). The SFRA is intended to be used to assist various parties consider flood risk when making planning decisions about the location and design of proposed future developments and flood risk management. It is therefore essential that the data contained within the SFRA is as up to date as possible to ensure that decisions are made on the best information available. Events that may trigger a review and update are summarised below:

- Changes to the NPPF and associated Flood Risk and Coastal Change PPG which form the basis of the SFRA.
- Updates to any of the overarching legislation which may alter the responsibilities of the London Borough of Richmond upon Thames.
- Updates to the available flood risk information used to develop the SFRA. There is a need to ensure developers, applicants and the LPA are provided with the best available information.
- Improved understanding of local flood risk knowledge. There is a need to ensure that site-specific FRAs are informed by the most up-to-date information and planning decisions are made on the best available data.
- Significant updates of baseline flood risk information (such as a major update to the Risk of Flooding from Surface Water Map or Flood Map for Planning).
- Updates following any significant flood risk investigation work conducted by Richmond.
- Following a major flooding event within the borough of Richmond upon Thames.

8.1.2 Mapping

The knowledge of flood risk is constantly changing and improving and the SFRA should reflect this. Not only could this enhanced knowledge highlight risk areas which were not previously at risk, it could also free up areas which may have been at risk but are no longer considered to be so. This could free up land for potential future development.

The Web Maps developed to support this SFRA provide a flexible platform for ensuring the most up-to-date information is available. Several Web Map layers are maintained externally by the EA and will be updated automatically when the EA publishes revised data – these layers include:

- EA Flood Map for Planning (River and Sea) - Flood Zone 2
- EA Flood Map for Planning (River and Sea) - Flood Zone 3
- EA Flood Map for Planning (River and Sea) - Areas Benefiting from Flood Defences
- EA Flood Map for Planning (River and Sea) - Flood Defences
- EA Flood Storage Areas
- EA Flood Alert Areas
- EA Flood Warning Areas
- EA Historic Flood Map
- Risk of Flooding from Surface Water Extent: 3.3 percent annual chance
- Risk of Flooding from Surface Water Extent: 1 percent annual chance
- Risk of Flooding from Surface Water Extent: 0.1 percent annual chance
- Risk of Flooding from Reservoirs - Maximum Flood Extent

The remaining Web Map layers are current at the date of writing this SFRA (March 2021) and will require updating in the future. It should be noted that the Flood Zone 3a and 3b layers are static and will require updating under the following circumstances:

- Updated main river flood extents are made available by the EA. The EA undertake periodic review and updates of main river flood models and associated predicted flood extents.
- Updates to the RoFSW map – If RoFSW data are factored into future Flood Zone 3a and/or 3b extents (as per recommendation 1 in *Section 7.7.1*), updates would occur when Richmond undertakes local surface water flood risk studies that provide surface water flood extents to the EA to update national mapping.

8.2 Level 2 SFRA

A Level 2 SFRA is a detailed assessment of all potential sources of flood risk for identified sites that require site-specific assessment. These allocation sites and/or windfall sites are identified as either part of the Local Plan or through the Level 1 SFRA.

The Level 2 SFRA builds on the strategic flood risk information presented in a Level 1 SFRA. If a Level 1 SFRA identifies that it is not possible to allocate all development outside of flood risk areas, then a Level 2 SFRA may be required. A Level 2 SFRA may also be required if it is believed that developers and applicants will submit a high number of applications on sites that are not identified in the Local Plan.

This Level 1 SFRA has identified that not all developments can be located outside of flood risk areas. It is therefore recommended that a Level 2 SFRA is produced to achieve the following:

- Identify the potential development sites that require a site-specific assessment.
- Complete a detailed site-specific FRA for each identified site, assessing all sources of potential flood risk at the site.
- Provide the information needed to apply the Exception Test where appropriate.
- Identify any site-specific requirements, including policy, mitigation measures, and FRA requirements.
- Provide a set of recommendations for each assessed site.

The Level 2 SFRA will consider flood risk from all sources both now and in the future with climate change considerations. The assessment will provide details on aspects such as extent, velocity, depth, and hazard ratings. The information presented will support proposals in submitting the necessary information to meet the requirements.

APPENDICES

Flood Risk Data Sources

APPENDIX – FLOOD RISK DATA SOURCES

1.1 Flood Risk Data Sources

The data sources listed below were collected and used for mapping purposes in this Level 1 SFRA project. Table 1 outlines the data used in the maps within this report. The source and limitations of each data file have been included.

WMS (Web Map Service) layers are live data feeds. The owner of the layer may perform regular updates to these layers. The WMS included in the maps will be the most up to date version of that layer at any particular time.

Table 1 – Flood Risk Data Sources

Data	Source	Limitations
Fluvial and Tidal Flood Risk Map		
Richmond Borough Boundary	Ordinance Survey Open Data	No known limitations.
Town Centre, Local Centre Boundary and Buffer	LBRuT	Please note that boundaries included relate to the SFRA and are consistent with the Local Plan Policies Map where they exist. The Local Plan Policies Map should be used for planning purposes.
Detailed River Network (DRN)	EA	The DRN is captured from the water features theme of the OS Master Map topographic layer and built into a network using automated rules. Other input datasets and extensive local Environment Agency staff knowledge has been used to augment the core geometry to incorporate critical spatial detail and attribution, such as flow direction and path, not available from the OS mapping and to verify the accuracy of the centreline itself.
Flood Zone 2	EA (WMS)	Land assessed as having a 1 in 1000 (0.1%) annual probability of river or sea flooding when the presence of flood defences is ignored. The information provided is largely based on modelled data and is therefore indicative rather than specific. Locations may also be at risk from other sources of flooding. The Flood Map for Planning (Rivers and Sea) only shows the predicted

Data	Source	Limitations
		likelihood of flooding from rivers or the sea for defined areas and is not detailed enough to account for precise addresses. Individual properties therefore may not always face the same chance of flooding as the areas that surround them. Symbology will need to be edited to adjust layer transparency.
Flood Zone 3	EA (WMS)	Land assessed as having a 1 in 100 (1%) or greater annual probability of river flooding, or with a 1 in 200 (0.5%) or greater annual probability of sea flooding in any year when the presence of flood defences is ignored. The information provided is largely based on modelled data and is therefore indicative rather than specific. Locations may also be at risk from other sources of flooding. The Flood Map for Planning (Rivers and Sea) only shows the predicted likelihood of flooding from rivers or the sea for defined areas and is not detailed enough to account for precise addresses. Individual properties therefore may not always face the same chance of flooding as the areas that surround them. Symbology will need to be edited to adjust layer transparency.
Flood Zone 3b	EA	The Tidal Thames, River Crane and Beverley Brook 1 in 20-year extents form the flood zone 3b outline.
Lower Thames Model	EA	Flood extents have been included for the 1 in 100 year event with climate change allowances of 25%, 35% and 70%.
River Crane Model	EA	Refer to EA River Crane SFRM Modelling and Mapping Study Final Report by Halcrow Group Limited May 2008. This was updated in 2017 to include new climate change allowances. Refer to EA Technical Note by JBA Consulting January 2018. Defended flood extents for the 1 in 100 year event plus climate change allowances of 25%, 35% and 70% have been included.
Beverley Brook Model	EA	Refer to EA Beverley Brook Flood Risk Mapping Study by Royal Haskoning 2008 March 2009. This was updated in 2017 to include new climate change allowances.

Data	Source	Limitations
		Defended flood extent for the 1 in 100 year event plus climate change allowance of 20% has been included.
Tidal Thames River Breach Hazard Ratings	EA	Refer to EA London Thames Breach Assessment Methodology Report and Technical Note by Atkins May 2017. Thames Tidal hazard rating modelled to the 2100 epoch has been included. Data for maximum depth, velocity and elevation is available from the EA.
River Crane Flood Hazard Ratings	EA	Refer to EA River Crane SFRM Modelling and Mapping Study Final Report by Halcrow Group Limited May 2008. This was updated in 2017 to include hazard ratings. Refer to EA Technical Note by JBA Consulting January 2018. Hazard ratings for the 1 in 100 year event plus climate change allowances 25%, 35% and 70% have been included.
Modelled Defence Breach Locations	EA	Refer to EA London Thames Breach Assessment Methodology Report and Technical Note by Atkins May 2017. The Tidal Thames defence line was used to define the breach locations.
Tidal Thames Breach Inundation Mapping	EA	Refer to EA London Thames Breach Assessment Methodology Report and Technical Note by Atkins May 2017. The map provides the maximum likely flood extent that would be achieved if an individual breach of the Thames Tidal Defence line was to occur at any point between Teddington Weir and the Thames Barrier. Breach inundation for the 2100 epoch has been included.
Flood Defences	EA (WMS)	This layer shows linear defences that act to prevent flood water from flowing inland. Typically, these can be man made embankments and walls but also naturally occurring processes such as shingle ridges and dunes. This information is designed to only give an indication of flood risk to an area of land and is not sufficiently detailed to show whether an individual property is at risk of flooding.
Areas Benefitting from Flood Defences	EA (WMS)	The Flood Map for Planning (Rivers and Sea) shows areas that would benefit from the presence of defences in a 1 in 100 (1%) chance of flooding each year from Rivers; or 1 in 200 (0.5 %) chance of flooding each year from the Sea. If the defences were not there, these areas would flood. The data does not show all areas that

Data	Source	Limitations
		benefit from all flood defences. The information provided is largely based on modelled data and is therefore indicative rather than specific.
EA Historic Flood Map	EA (WMS)	This shows the maximum extent of all individual recorded flood outlines from rivers, the sea and groundwater springs and shows areas of land that have previously been subject to flooding in England. Records began in 1946 when predecessor bodies to the EA started collecting detailed information about flooding incidents, although the EA may hold limited details about flooding incidents prior to this date. This dataset differs from the Recorded Flood Outline dataset in that it contains only those flood outlines that are 'considered and accepted' if the following criteria are met: • photographic/video evidence with the location referenced. • recorded flood levels with the location referenced. • evidence that the outline represents the time of peak water level (for example date / time stamped photo). evidence that the source of flooding is from rivers, the sea or groundwater and not surface water/overland runoff.
Flood Storage Areas	EA (WMS)	The information on the Flood Map for Planning (Rivers and Sea) is designed to only give an indication of flood risk to an area of land and is not sufficiently detailed to show whether an individual property is at risk of flooding. The flood data is improved and updated quarterly. Some areas that already benefit from recently completed flood defences may not yet be indicated on these maps. It has been assumed that flood storage areas act perfectly and give the same level of protection as when the assessment of the area was carried out. Flood storage areas do not completely remove the chance of flooding and can be overtopped or fail in extreme weather conditions.
Flood Warning Areas	EA (WMS)	Flood Warning Areas are geographical areas where the EA expect flooding to occur and where it provides a Flood Warning Service.

Data	Source	Limitations
Flood Alert Areas	EA (WMS)	Flood Alert Areas are geographical areas where it is possible for flooding to occur from rivers sea and in some location's groundwater. The greatest extent of flooding defined using Flood Zone is used to delineate the Flood Warning Service Limit which is subdivided into Flood Alert Areas.
NFM (Natural Flood Management) data	EA	Flood management measures recorded along the Beverly Brook and the River Crane.
Surface Water Flood Risk Map		
Richmond Borough Boundary	Ordinance Survey Open Data	No known limitations.
Town Centre, Local Centre Boundary and Buffer	LBRuT	Please note that boundaries included relate to the SFRA and are consistent with the Local Plan Policies Map where they exist. The Local Plan Policies Map should be used for planning purposes.
Detailed River Network (DRN)	EA	See above.
Surface Water Flood Maps (extent)	EA (WMS)	This mapping consists of the flood extent of rainfall scenarios with a 3.3% (1 in 30), 1% (1 in 100) and 0.1% (1 in 1000) chance of occurring in any given year: It is not suitable to be used: • to identify if an individual property will or will not flood. • in detailed flood risk assessments. • on a map with background mapping more detailed than 1:10,000. It does not: • show future scenarios, for example climate change. • show flooding from other sources, including overflowing watercourses, drainage systems or public sewers, river flow, groundwater or the sea. • include the presence or effect of pumping stations in catchments with pumped drainage. • include any allowance for tide locking, high levels or fluvial levels where sewers cannot discharge.

Data	Source	Limitations
		This means that where these elements play a role in the way flooding happens, this information may not show what occurs locally. Data on depth, hazard and flow direction is available from the EA. Symbology will need to be edited to adjust layer transparency.
NFM (Natural Flood Management data)	EA	See above.
Groundwater, Sewer and Artificial Flood Risk Map		
Richmond Borough Boundary	Ordinance Survey Open Data	No known limitations.
Town Centre, Local Centre Boundary and Buffer	LBRuT	Please note that boundaries included relate to the SFRA and are consistent with the Local Plan Policies Map where they exist. The Local Plan Policies Map should be used for planning purposes.
Susceptibility to Groundwater Flooding	EA	Areas Susceptible to Groundwater Flooding (AStGWF) is a strategic scale map showing groundwater flood areas on a 1km square grid. It shows the proportion of each 1km grid square where geological and hydrogeological conditions show that groundwater might emerge. It does not show the likelihood of groundwater flooding occurring. The data should not be interpreted as identifying areas where groundwater is actually likely to flow or pond, thus causing flooding.
Groundwater Flooding	BGS	Subject to licence agreement with BGS. To be used for internal use only. Not to be made public. See licence agreement for more details. Refer BGS Susceptibility to groundwater flooding exploratory notes for users. The susceptibility data is suitable for use for regional or national planning purposes where the groundwater flooding information will be used along with a range of other relevant information to inform land-use planning decisions. The

Data	Source	Limitations
		susceptibility data cannot be used on its own to indicate risk of groundwater flooding.
Increased Potential for Elevated Groundwater	GLA Drain London 2011	This map identifies areas that have increased potential to experience elevated groundwater levels in response to higher that average recharge from rainfall or from elevated river levels.
Geology	BGS	Subject to licence agreement with BGS. To be used for internal use only. Not to be made public. See licence agreement for more details. Refer BGS Digital Geological Map of Great Britain, information notes, 2013 and Accuracy of BGS legacy digital geological map data report 2009. Geological mapping is not an exact science and is based on the evidence and data available at the time of survey. Whilst all maps are representations, geological maps are often also largely interpretations. This is particularly true in the UK where there is relatively poor exposure because of extensive vegetation and soil cover. There is often, therefore, limited direct observation of the bedrock and superficial deposits, and where the geology is not visible in the UK it is usually interpreted. Includes artificial, superficial and bedrock geology.
Number of Sewer Flood Incidents	Thames Water	This data shows where Thames Water have received reports of sewer flooding. This data was provided in partial postcode format. Therefore the dataset does not specify where the flooding is occurring at property level.
Risk of Flooding from Reservoirs – Maximum Flood Extent	EA (WMS)	The reservoir flood map outline (extent) shows the largest area that might be flooded if a reservoir were to fail and release the water it holds. Since this is a prediction of a credible worst-case scenario, it is unlikely that any actual flood would be this large. These data are intended for emergency planning only and are not reliable for large scale flood risk assessments. Please note that only flood maps for large reservoirs are displayed. Flood maps are not displayed for smaller reservoirs or for reservoirs commissioned after reservoir mapping began in spring 2009.

Data	Source	Limitations
Policy Map		
Richmond Borough Boundary	Ordinance Survey Open Data	No known limitations.
Town Centre, Local Centre Boundary and Buffer	LBRuT	Please note that boundaries included relate to the SFRA and are consistent with the Local Plan Policies Map where they exist. The Local Plan Policies Map should be used for planning purposes.
Detailed River Network (DRN)	EA	See above.
Flood Zone 2	EA (WMS)	See above.
Flood Zone 3	EA (WMS)	See above.
Flood Zone 3b	EA	See above.
Surface Water Flood Maps (extent)	EA (WMS)	This mapping consists of the flood extent of rainfall scenarios with a 3.3% (1 in 30) and 1% (1 in 100) chance of occurring in any given year. See above for limitations.
Article 4 Direction	LBRuT	Refer to the following LBRuT website for more information. https://www.richmond.gov.uk/services/planning/article_4_directions_basements
Susceptibility to Groundwater Flooding	EA	Areas Susceptible to Groundwater Flooding (AStGWF) is a strategic scale map showing groundwater flood areas on a 1km square grid. It shows the proportion of each 1km grid square where geological and hydrogeological conditions show that groundwater might emerge. It does not show the likelihood of groundwater flooding occurring. The data should not be interpreted as identifying areas where groundwater is actually likely to flow or pond, thus causing flooding.
Flood Defences	EA (WMS)	See above.
Areas Benefitting from Flood Defences	EA (WMS)	See above.
Flood Storage Areas	EA (WMS)	See above.

Basement Assessment User Guide

1. Basement Assessment Process:

This guidance applies to all development proposals that feature basements, cellars, or other subsurface structures (collectively termed as 'basements' within this document). This includes new structures and extensions to existing structures. This document is designed to guide users through the requirements of the Basement Assessment process for a range of environmental impacts. This guide should be used in conjunction with the London Borough of Richmond upon Thames' Strategic Flood Risk Assessment (SFRA) and associated Further Groundwater Investigations document.

Planning applications which feature basements will need to provide supporting information regarding the potential level of impact the proposed development will have. The applicant will need to show that the proposal will not adversely impact the site, neighbouring properties, and the wider natural environment. This includes impacts to groundwater and water transferred via throughflow.

Applications may require a Screening Assessment (as a minimum) depending on the location of the proposed development. See Section 3 for further information.

2. Stages of a Basement Assessment:

The Basement Assessment process needs to enable the London Borough of Richmond upon Thames to assess the potential impacts of a proposed subsurface development. Depending on the predicted level of impact, applicants will need to produce and submit information in line with the following stages of the Basement Assessment process. All documentation must be provided within the proposed development's planning application submission.

1. **Screening Assessment** – A Screening Assessment is used to identify any potential matters that may have an adverse impact and determine if a Basement Impact Assessment is required. If the answer to any of the screening questions (see Section 4) is "yes", or is currently unknown, matters relating to that question will need to be addressed as part of a Basement Impact Assessment. Accompanying information to justify responses included within the Screening Assessment should be provided and signed off by the chartered professional who carried out the assessments for the supporting evidence (see Section 6).

Ahead of preparing a Basement Impact Assessment, a scoping step should be carried out to determine the extent of the potential impacts identified as part of the Screening Assessment. Scoping should be used to set the boundaries of the Basement Impact Assessment and establish what the assessment will address. Additional information may be collected to help with this process. To further gain a better understanding of the site and the immediate area, desktop, and field surveys (where required) should be carried out. The type and degree of such site investigations carried out is dependent on what was identified as part of the Screening Assessment. These will support the Basement Impact Assessment.

2. **Basement Impact Assessment** – The Basement Impact Assessment should evaluate the potential direct and indirect impacts of the proposed development. It is required that a Basement Impact Assessment is carried out and signed off by a chartered professional, depending on the type of expertise required (see Section 5 and Section 6).

Whether it is a Screening Assessment or a Basement Impact Assessment, the London Borough of Richmond upon Thames will rely on the professional integrity of the person signing off the assessment to ensure that the construction of the basement can be undertaken safely. To support with their decision making, the London Borough of Richmond upon Thames may choose to consult, at the applicant's expense, an independent chartered structural engineer with expertise in historic structures for specific cases where particularly vulnerable historic buildings or structures may be affected. Further consultation may also be sought from an independent chartered professional or specialist regarding any of the three categories covered by the Screening Assessment. This would normally be carried out as part of the consideration of the planning application.

3. Screening Assessment Guidance

The following steps explain how users can identify whether a proposed development requires the submission of a Screening Assessment during the planning process.

Step 1:

Determine through the London Borough of Richmond upon Thames' SFRA map if the proposed property falls within one of the two following borough designations:

- an area with >= 25% susceptibility to groundwater flooding
- one of the four throughflow catchment areas

If the proposed development falls within one (or both) of these two designations, and contains a basement, then the applicant needs to complete a Screening Assessment.

Step 2:

The type of information required within a Screening Assessment is determined by the answers to the set of questions set out in Section 4 of this User Guide.

For all questions where the response is "yes", or where the answer is currently unknown, these matters should be taken forward and investigated as part of the Basement Impact Assessment. Questions where the response is "no" should have accompanying information / supporting evidence to justify the response, structured within a Screening Assessment document that addresses each of the questions. For further guidance on the requirements of a Basement Impact Assessment, see Section 5.

Step 3:

In instances where the accompanying information / supporting evidence provided as part of the Screening Assessment was undertaken by a chartered professional, the information should be signed off by the specialist who carried out the works (see Section 6). A completed version of the form should be provided as part of the Screening Assessment to confirm that the supporting information provided aligns with the answers provided in response to the Screening Assessment questions.

4. Screening Assessment Questions

The purpose of the Screening Assessment is to identify if there are any potential issues which would require a more detailed investigation into the suitability of a proposed development due to groundwater influenced flood risk factors. If so, a Basement Impact Assessment should be carried out. To identify if this is required, the following categories of information should be covered as part of the Screening Assessment:

- Subterranean characteristics
- Land stability (including site slope)
- Flood risk and drainage (including throughflow, groundwater and surface water)

Analysis undertaken by the applicant should be based on the proposed development site's characteristics and focus on the impact on the site, neighbouring properties, and the wider natural environment. The following questions, split into the above three information categories, should also be addressed within the Screening Assessment:

Subterranean Characteristics

- Does the recorded water table extend above the base of the proposed subsurface structure?
- Is the proposed subsurface development structure within 100m of a watercourse or spring line?
- Are infiltration methods proposed as part of the site's drainage strategy?
- Does the proposed excavation during the construction phase extend below the local water table level or spring line (if applicable)?
- Is the most shallow geological strata at the site London Clay?
- Is the site underlain by an aquifer and/or permeable geology?

Land Stability

- Does the site, or neighbouring area, topography include slopes that are greater than 7˚?
- Will changes to the site's topography result in slopes that are greater than 7˚?
- Will the proposed subsurface structure extend significantly deeper underground compared to the foundations of the neighbouring properties?
- Will the implementation of the proposed subsurface structure require any trees to be felled or uprooted?
- Has the ground at the site been previously worked?
- Is the site within the vicinity of any tunnels or railway lines?

Flood Risk and Drainage

- Will the proposed subsurface development result in a change in impermeable area coverage on the site?
- Will the proposed subsurface development impact the flow profile of throughflow, surface water or groundwater to downstream areas?
- Will the proposed subsurface development increase throughflow or groundwater flood risk to neighbouring properties?

As part of answering the Screening Assessment questions, applicants are required to provide information to justify their answers. Examples of information that is expected as part of the Screening Assessment include, but is not limited to:

- Description of the proposed basement, cellar, or other subsurface structure development.
- Construction methods proposed.

- Characteristics of the site, including geological information (bedrock, superficial deposits, and aquifer confirmation) and topographical information.
- Site borehole information with water levels. Historical borehole data from sources such as the British Geological Survey may be acceptable to help justify answers provided within the 'Subterranean Characteristics' section of the Screening Assessment. If historical borehole data is used, the borehole location must be within 100m of the site and have been conducted within the last 20 years to best capture the current local conditions. However, singular borehole measurements may not provide information on what subterranean conditions might look like at a different time in the year. Groundwater flow and throughflow may be subjected to seasonal influences. Therefore, it will be necessary to monitor subterranean water levels over a period of time in areas that may be more susceptible to groundwater and throughflow. For further information on monitoring subterranean water level conditions as part of an impact assessment, see Section 5.
- Characteristics of potential impacts (including the impact on soils, water quality and hydrology).
- Details of mitigation measures (where appropriate).

5. Basement Impact Assessment

For all Screening Assessment questions where the response is "yes", or where the answer is currently unknown, these matters should be taken forward and investigated as part of the Basement Impact Assessment. Depending on what categories of information which need to be covered, the Basement Impact Assessments must be carried out by a chartered professional who can carry out the required assessment(s). Examples of specialists that have the required skills and qualifications to carry out assessments necessary for a Basement Impact Assessment include:

- Civil engineer
- Geotechnical specialist
- Geologist
- Hydrologist
- Hydrogeologist

Guidance provided under 'Structural Impact Assessments' as part of the Good Practice Guide on Basement Developments (2015) should be followed to produce a Basement Impact Assessment. It must include a detailed geotechnical site investigation, site plans outlining the subsurface structure, and engineering information detailing the potential impacts of the proposed development. Depending on the matters flagged up as part of the Screening Assessment, other content that may be included or referenced as part of the Basement Impact Assessment include a:

- Flood Risk Assessment
- Demolition and Construction Management Plan
- Site Waste Management Plan
- BREEAM Assessment
- Environmental Impact Assessment / Environmental Statement

The Basement Impact Assessment should be signed off by the specialist who carried out the investigatory works (see Section 6). The submission should also demonstrate that the level of risk posed to neighbouring properties and the wider environment is low. It must also include, but is not limited to, the following details:

- Detailed borehole information on-site or from nearby to the development site. At least two data recordings should take place within at least a 12 month period to demonstrate any potential seasonal variations. As subterranean water conditions are subject to various seasonal and yearly influences, it is important to monitor any potential changes over a period of time. The subterranean measurements should identify the geological conditions on or close to the development site, the infiltration potential, and the height of any local groundwater.
- Mitigation if the identified potential impacts of the proposed subsurface development are not acceptable. If, for example, the assessment identifies that the proposed development may result in water ingress to the new development and/or to neighbouring properties, then mitigation measures should be proposed to reduce and/or alleviate the risk of flooding. Flood risk must not be worsened as a result of the proposed development. Examples of flood risk mitigation include, but are not limited to, the following:
    - Underground corridors with a high permeability
    - Controlled subsurface structure drainage systems (including pumps)

6. Site and Assessment Verification Form

This Site and Assessment Verification form should be completed and submitted as part of the planning application. The 'Chartered Professional Verification' table should be completed by the specialist that undertook the required assessment(s) (Screening Assessment and / or Basement Impact Assessment). If chartered professionals from different expertise areas carried out parts of the assessment(s), please ensure that separate Site and Assessment Verification forms are completed and submitted.

Site Details

Site Details	Applicant Information
Site name	
Planning application reference (if applicable)	
Address & postcode	
Brief description of the proposed works	
Geology type	
Presence of aquifer?	
Total site area (Ha)	
Is the site currently known to be at risk of flooding from any sources?	

Chartered Professional Verification

Professional Details	Applicant Information
Name	
Profession / area of expertise	
Chartered institution and membership level	
Brief description of assessment involvement	
Brief summary of the assessment results	
Declaration of assessment results	
Signature	

APPENDIX D – GROUNDSURE INFORMATION (2009 VERSION)

Chelmer
Consultancy Services
'Groundbreaking Services'

Desk Top Study Report

Site	Ham Close
	Richmond Upon Thames
	London
	TW10 7PG
Client	Richmond Housing Partnership
Date	11th August 2017
Our Ref	DTS/9324

Chelmer Site Investigation Laboratories Ltd
Unit 15 East Hanningfield Industrial Estate, Old Church Road, East Hanningfield, Essex CM3 8AB
Essex: 01245 400930 | London: 0203 6409136 | info@siteinvestigations.co.uk | www.siteinvestigations.com

PHASE 1 ENVIRONMENTAL REPORT
of a site at
HAM CLOSE, RICHMOND UPON THAMES, LONDON, TW10 7PG
for
RICHMOND HOUSING PARTNERSHIP

Project No 9324
Report ref: 9324-P1E-1
Issued: 11 August 2017
Revision:

Chelmer Global Ltd
Unit 15 East Hanningfield Industrial Estate, Old Church Road, East Hanningfield, Essex CM3 8AB
T: 01245 400930 | E: info@chelmerglobal.co.uk | W: www.siteinvestigations.com

CONTENTS

1 EXECUTIVE SUMMARY

Details	Summary	
Proposed Development	Residential with soft landscaping	
Current Site Use	Residential and commercial	
Site History	Historical mapping shows site initially used as farm land later developed for residential and commercial use	
Surrounding Area	Residential	
Environmental Setting	Geology	Superficial: Kempton Park Gravel Formation Bedrock: London Clay Formation
	Hydrogeology	Superficial: Secondary A Aquifer Bedrock: Unproductive Strata
		Source Protection Zone: SPZ NA
Potential Contamination Sources	The site walkover, historical mapping and environmental searches have identified the following potential sources of contamination. • Car park, lock up garages, electricity substations on site • Demolition debris & imported hard core • Nearby commercial activity • Naturally occurring contaminants • Unknown nature of fill material on-site & off site	
Risk Assessment Findings	Risk ratings of moderate or greater indicate potentially complete source-pathway-receptor linkages that can require further investigation and remedial measures. The following moderate or greater risks have been identified at the site. • Migration, build up in buildings and explosion of hazardous gases • Site users in contact with contaminated soil • Site users inhaling contaminated dust • Proposed buildings in contact with contaminated soil • Site users and workers inhaling fibres (asbestos)	
Recommendations	Some preliminary intrusive environmental site investigation is recommended to determine if either contamination and, or, landfill gas are present on the property. It is not considered that an upgraded water supply pipe is required, however it is recommended that this report is provided to the water supplier with a request for the testing, if any, that they require. It is considered that provided the recommendations of this report are implemented there is no increased risk to human health from redevelopment of the site for the proposed use.	

Risk Summary

Very Low	Low	Moderate / Low	Moderate	High

		Receptors					
		Residents & Site Users	Construction & Maintenance Operatives	Neighbours	Proposed Building	Aquifer	Watercourse
Sources	Car park, lock up garages, electricity substations, demolition debris & imported hard core on site						
	Demolition debris & imported hard core (asbestos)						
	Unknown nature of fill material on-site & off site						
	Nearby commercial activity						
	Nursery (off site)						
	Naturally occurring contaminants						

2 BRIEF

Mr Alec Thomson of Pellings requested a phase 1 environmental desk top study for a site at Ham Close, Richmond upon Thames, London, TW10 7PG on behalf of Richmond Housing Partnership.

The purpose of this report is to assess the risks to sensitive receptors both on and off-site due to soil and groundwater contamination as a result of the proposed development. It is based upon information provided by the client, a site visit, walk over and a Landmark Envirocheck, historical aerial photographs and maps.

This report is based upon available factual data for the site obtained only from the sources described in the text and related to the site on the basis of the location information provided by the Client. The desk study information is not necessarily exhaustive and further information relevant to the site may be available from other sources.

3 SITE VISIT

The site was visited on 21 July 2017. The weather was dry and sunny. Access was available to all external areas of the site, except for the school playing field and the Ham Day Centre and a visual inspection was undertaken. A photographic record was made during the visit and this is contained in appendix B.

The client's confidentiality was maintained at all times during discussion with third parties.

4 SITE LOCATION

The site is situated in the area of Ham, in the London borough of Richmond upon Thames. Refer to Figure 1.

The National Grid Reference for the approximate site centre is 517160, 172360.

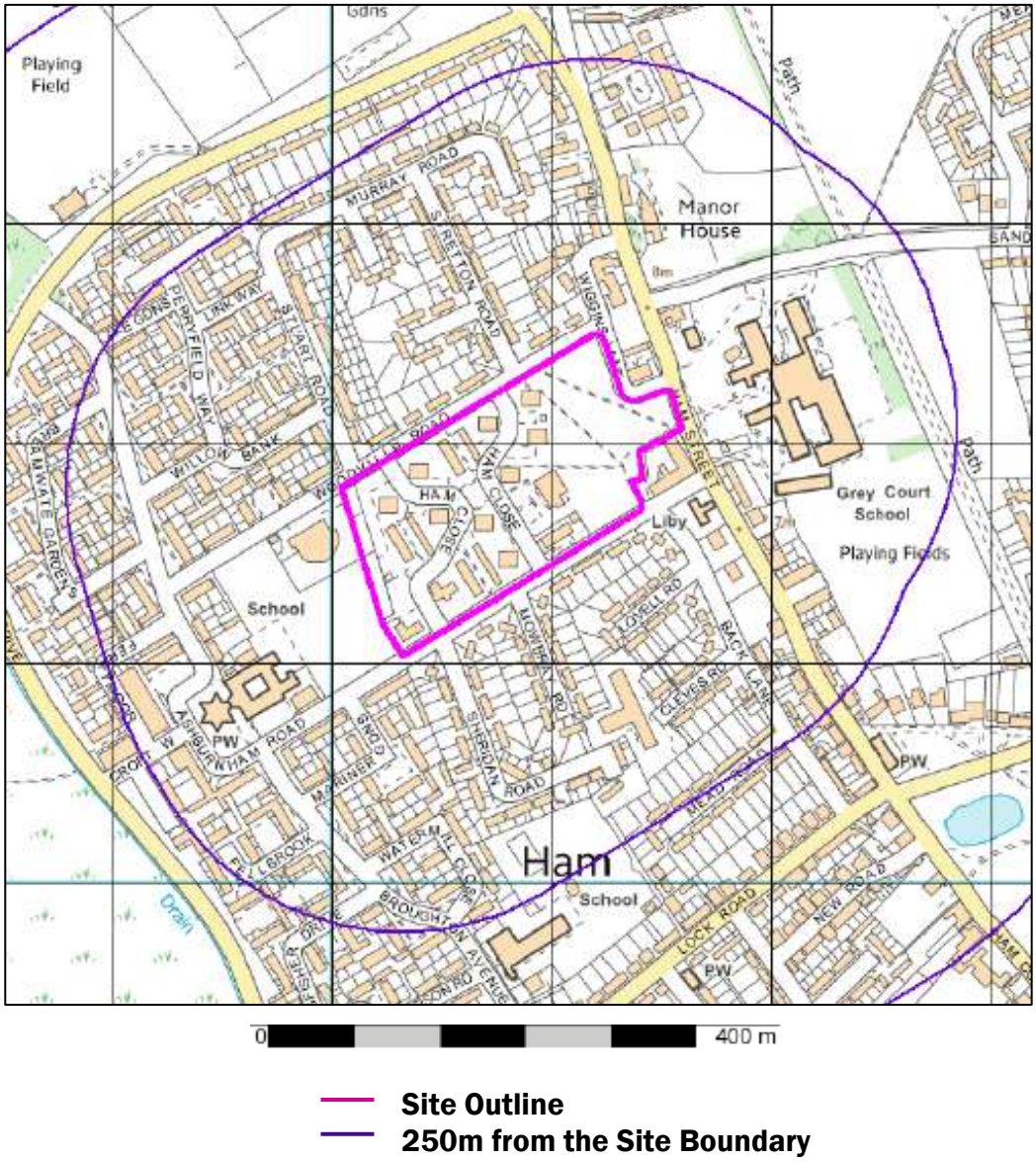


Figure 1: Site Location Plan

5 SITE DESCRIPTION

The site is very approximately rectangular shaped in plan and occupies 4.58ha. The north boundary is defined by Woodville Road. The eastern boundary at the southern end is defined by the estate boundary wall, the boundary then runs north-northeast across the school playing field and the Ham Day Centre. The southern boundary is defined by Ashburnham Road. The western boundary is formed by Wiggins Lane and Ham Street and in the southeast corner by the service yard and shops fronting onto Ham Street and Ashburnham Road.

Photograph 1: View of the site from the east

The east end of the site is grassed communal open space with an asphalt surfaced car park in the southeast corner. There is an electricity sub-station in the service yard, immediately next to the southeast corner of the site.

The greater part of the remainder of the site comprises a residential estate, with three, four and five storey blocks, three runs of lock-up garages, small enclosed individual storage areas, asphalt surfaced car parks, a Community Hall, a Clinic the Ham Friends Club building and associated asphalt surfaced estate roads. Areas between the blocks are laid to grass with some trees and bushes. There is an electricity sub-station on site near the west boundary.

There is a school to the east of the site, a school playing field and the Ham Day Centre to the west of the site and a terrace of small shops with a service yard and electricity sub-station to the southeast of the site. Other than the above the surrounding area appears to be residential.

6 GROUND CONDITIONS

6.1 Geology

Reference to the geological survey of Great Britain indicates that beneath made ground, the area generally is underlain by superficial deposits comprising sand and gravel which is described as Kempton Park Gravel Formation.

The superficial deposits are underlain by bedrock comprising clay and silt described as London Clay Formation.

6.2 Hydrogeology

The Environment Agency maps show the site to be located over a Secondary A Aquifer in the superficial or drift deposits, in the bedrock they show the site to be over an Unproductive Strata.

Secondary A Aquifers comprise permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.

The soils overlying the aquifers are assumed to have a high leaching potential (U) and a worst case vulnerability classification (H) is assumed due to a lack of data available for restored workings and urban areas.

The Environment Agency maps show the site is not located within a source protection zone of a borehole abstraction point.

The Environment Agency define a zone according to how the groundwater behaves in that area. From this a model of the groundwater environment is developed on which to define the zones.

Groundwater source catchments are divided into three zones:

SPZ1 – Inner protection zone

Defined as the 50 day travel time from any point below the water table to the source. This zone has a minimum radius of 50 metres.

SPZ2 – Outer protection zone

Defined by a 400 day travel time from a point below the water table. This zone has a minimum radius of 250 or 500 metres around the source, depending on the size of the abstraction.

SPZ3 – Source catchment protection zone

Defined as the area around a source within which all groundwater recharge is presumed to be discharged at the source. In confined aquifers, the source catchment may be displaced some distance from the source. For heavily exploited aquifers, the final Source Catchment Protection Zone can be defined as the whole aquifer recharge area where the ratio of groundwater abstraction to aquifer recharge (average recharge multiplied by outcrop area) is >0.75.

6.3 Hydrology

The nearest water course to the site would appear to be a drain which is approximately 295 metres to the southwest at the nearest point. This is considered to be too distant to be significantly impacted by the site

The Environment Agency maps show the site is not located within a flood zone.

The British Geological Society data shows the site lies in an area with potential for groundwater flooding of property situated below ground level and potential for groundwater flooding to occur at surface.

Copy of extracts from the Landmark report are contained in appendix C.

6.4 Ground Stability Hazards

Infilled ground has been identified 41 to the south west, worked ground (Undivided) has been identified 361 to the west and 320 to the south east.

The ground beneath the site has been identified as having a very low risk of potential ground instability due to collapsible ground, landslide ground, running sand ground. These risks would be expected to manifest themselves as excessive settlement in the buildings on the site. However, the risks identified are considered unlikely to be of concern to any new buildings, as the foundation design will be based upon geotechnical information obtained from a site-specific intrusive investigation.

6.5 Mining Activities

Reference to the Coal Authority data indicates that the site is not within an area of known coal mining. There is no other known mining in the area.

6.6 Radon Gas

The Landmark Envirocheck Data also advises that the site lies within an area where less than 1% of properties are above the action level and that no protection measures are required in the construction of new properties.

6.7 Sensitive Land Use

Environmentally Sensitive Areas include Nitrate Sensitive Areas, Sites of Special Scientific Interest (SSSI's), Areas of Outstanding Natural Beauty (AONB), National Parks, National Nature Reserves, Special Areas of Conservation, Special Protection Areas and RAMSAR sites. According to the Landmark Envirocheck Data, the Site is not located on or close to any such Environmentally Sensitive Areas.

7 SITE HISTORY

Copies of the Historical Ordnance Survey maps that have been obtained from The Landmark information group are contained in appendix D.

The maps have been reviewed and items of interest and potential sources of contamination, both on the site and within the surrounding area up to 500 metres from the site boundary are noted hereunder.

Site Usage

From	To	Description
1850	1868	Site appears to be occupied by open land with a path way across the south and east part of the site.
1868	1896	Site appears to be occupied by buildings in the eastern part of the site and the site is labelled as a farm.
1896	1947	Site appears to have change of buildings in the eastern part of the site.
1947	1959	Site appears to now be a residential area with some open grass space.
1959	1969	There appears to be a ruin in the east part of the site.
1969	1983	Ruin appears to no longer be onsite. The site appears to no longer have any residential buildings in the east part of the site and a development of residential housing in the west part of the site. The west part of the site overlays part of a school adjacent to the site. Appears to be a clinic in the southern part of the site.
1983	2017	A car park shown in the south-eastern part of the site.

Surrounding Area

From	To	Name	Direction	Distance (m)
1868	1959	Pit	E	206
1871	-	Pond	SE	403
1913	1934	Smithy	SE	250
1913	1959	Gravel Pit	W	527
1913	1959	Sewage Works	S	155
1913	-	Riffle Range	NW	323

From	To	Name	Direction	Distance (m)
1933	1960	Cedar Nursery	N	107
1934	1959	Sand and Gravel Works	W	542
1934	1960	Sand and Ballast Works	SW	340
1959	1969	Lake	NW	111
1933	1971	Tanks/Disused Works	S	212
1959	-	Plant Nursery	N	296
1973	-	Pumping Station	S	202
1973	-	Tank	S	195

8 PROPOSED DEVELOPMENT

Plan details for the proposed redevelopment is not available. Proposed development will be residential dwellings with private and communal gardens and non-residential buildings.

9 POTENTIAL CONTAMINATION

9.1 General

From observations made during the site visit and review of the historical maps and the Landmark information, potential sources of on-site contamination and off-site contamination have been identified.

No significant potential sources of contamination have been identified beyond a 250 metre boundary which are considered likely to have any impact on the site. Where there are similar industries and activities in the same direction, only the nearest has been listed.

Copies of the relevant extracts are contained in appendix C.

The legislative framework for the regulation of contaminated land is embodied in Part IIA of the Environmental Protection Act 1990, implemented in the Contaminated Land (England) Regulations 2000. This legislation allows for the identification and remediation of land where contamination is causing unacceptable risks to human health or the wider environment. The approach adopted by UK contaminated land policy is that of "suitability for use" which implies that the land should be suitable for its current use and made suitable for any proposed future use.

In this preliminary contamination assessment, the site has been modelled using the Source-Pathway-Receptor approach to produce a site specific conceptual model.

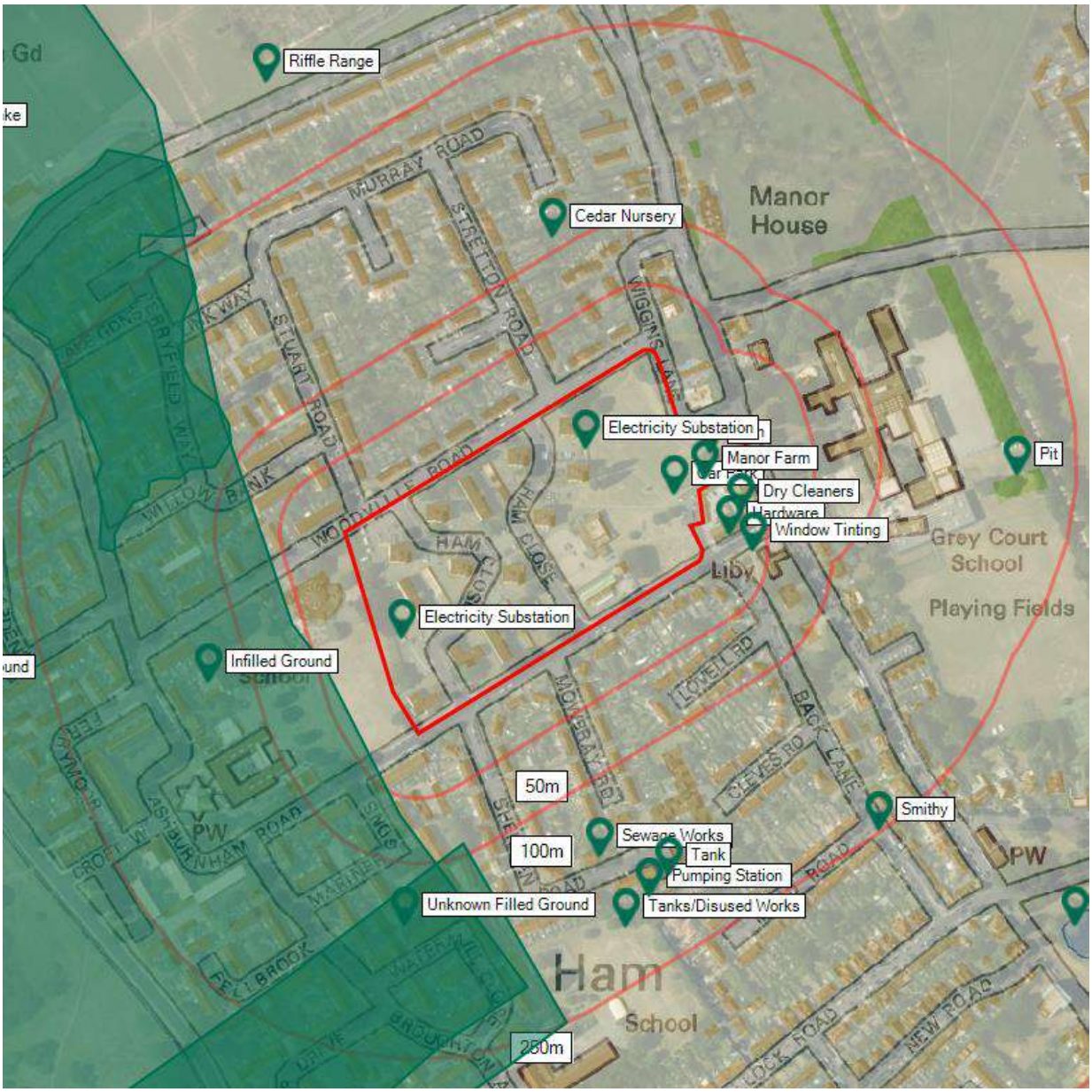
- **Source** - substances or potential contaminants which may cause harm
- **Pathway** - a linkage or route between a source and receptor
- **Receptor** - humans, plant life, groundwater etc., which could be harmed by a contaminant

Geological records indicate that the site is underlain by an aquifer in the superficial stratum and therefore there is a potential for contaminants to be transported both to and from site in the groundwater.

9.2 Off Site Contamination

Description	Direction	Distance (m)
Discharge Consents:		
Sewage Discharge to Tidal Thames from 1989 to 2010 – Status: Surrendered	SE	214
Sewage Discharge to Tidal Thames from 2010 to 2015 – Status: Temporary Consents	SE	214
Local Authority Pollution Prevention & Controls:		
PG6/46 Dry Cleaning - Permitted	E	19
Category 1 and 2 Pollution Incidents to Controlled Waters:		

Description	Direction	Distance (m)
None identified.	-	-
Prosecutions Relating to Authorised Processes:		
None identified.	-	-
Substantiated Category 1 and 2 Pollution Incidents:		
None identified.	-	-
Control of Major Accident Hazards Sites (COMAH) & Planning Hazardous Substance Consents		
None identified.	-	-
Landfill and Other Waste Sites:		
Unknown Filled Ground (Pit, Quarry etc) - 1992	S	92
Historical and Current Land Uses:		
Dry Cleaners	E	19
Hardware	E	20
Dry Cleaners	E	20
Window Tinting	E	26
Blast Cleaning	S	138
Laboratory Equipment, Instruments & Supplies	SW	155
Photo & Digital Imaging Bureaus	SW	158
Cinema Equipment	W	160
Office Furniture & Equipment	SE	194
Cleaning Services - Domestic	SW	199
Washing Machines - Servicing & Repairs	SW	241
Artificial Ground and Made Ground:		
Infilled Ground	SW	41



Potentially contaminating commercial activities have been identified in the vicinity, the general topography falls to the south, southwest and west towards River Thames this is assumed to be the general direction of the hydraulic gradient, sources to the north, northeast and east are therefore considered to have the potential to impact the site.

Potential sources identified on the historical maps and data sheet include: dry cleaners 19m and 20m, east; hardware 20m, east; window tinting 26 m, east and cedar nursery 107 m, north of the site. A potential source of contamination may also include the electricity sub-station in the service yard, immediately next to the southeast corner of the site.

Credible pathways for ground gas exist from an area of *Unknown Filled Ground*–92m south, Infilled ground 41m southwest and a pit 206m east from the site. These risks are considered further within the risk assessment.

9.3 On Site Contamination

There is potential contamination of the site from its use as a car park, lock up garages and electricity substations present on the site.

Review of the historic maps show the site has undergone redevelopment. Demolition debris may be present at the site and may comprise a potential source of contamination, including asbestos. Any hardcore below ground slabs or paved areas may also comprise a potential source of contamination.

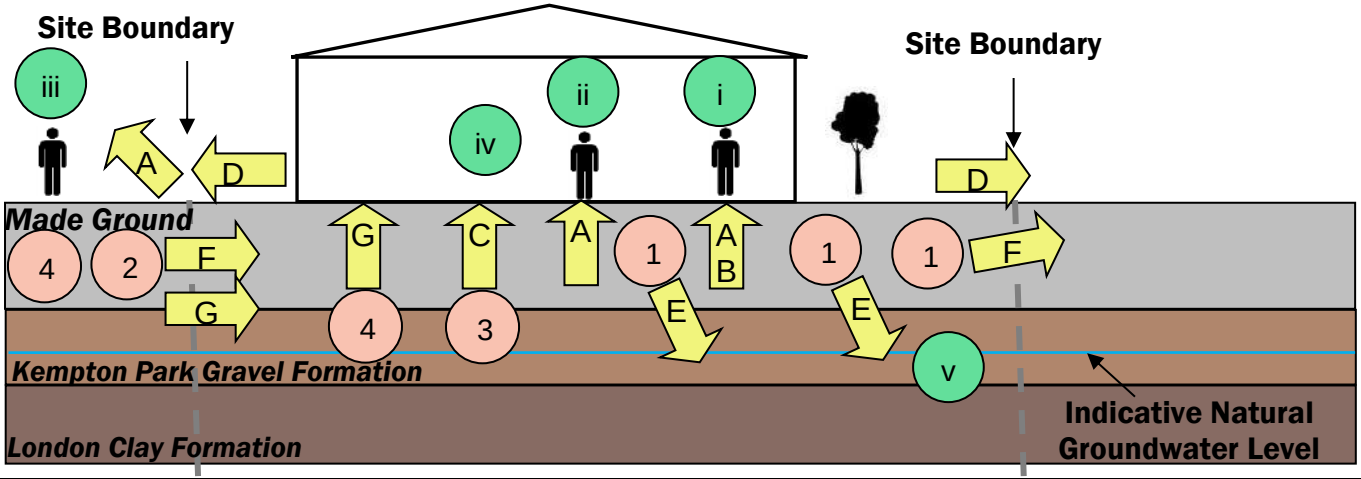
From review of the historical maps, the site would appear to have undergone major redevelopment. It is therefore considered there may potentially be a significant depth of fill material beneath the site, this is considered a potential on-site source of ground gas.

Richmond Upon Thames was subjected to bombing runs during World War II. In accordance with CIRIA C681 a non-specialist UXO assessment of the site has been undertaken. Several records of high explosive bombs have been identified within the site on The Bomb Sight project web-mapping tool, recorded locations are shown on middle section of the site parallel to Woodville Road and Ashburnham Road. It is considered that as the area has since undergone redevelopment, any bombs would have been identified at the time and dealt with during construction. However, those working on the site should be made aware of the potential for unexploded ordnance and given appropriate guidance. Information to be contained in site Health & Safety Plan.

9.4 Preliminary Conceptual Model

		Potential pathways											
		Inhalation of contaminated vapour	Inhalation of contaminated dust	Direct Soil Ingestion	Direct dermal contact	Inhalation of asbestos	Drinking contaminated water supply	Direct contact of soil with building materials	Surface water run-off	Surface water percolation to groundwater	Migration via groundwater	Build-up of ground gas	Comments on discounted pathways
Receptors	Site Users / Residents	Y	Y	Y	Y	Y	Y					Y	
	Construction / Maintenance Operatives	Y	Y	Y	Y	Y						Y	
	Neighbours	Y	Y			Y			Y		Y	Y	
	Proposed Building							Y				Y	
	Watercourse								N		N		Nearest water course too far to be impacted by site.
	Aquifer									Y			

Schematic Conceptual Model



(Not to Scale)

Sources		Pathways		Receptors	
1	Car park, lock up garages, electricity substations, demolition debris & imported hard core (On Site)	A	Inhalation, ingestion, dermal contact, vapours	i	Residents & Site User
2	Nearby commercial activity (Off Site)	B	Drinking contaminated water supply	ii	Construction & Maintenance Operatives
3	Naturally occurring contaminants	C	Direct contact of soil with building materials	iii	Neighbours
4	Unknown nature of fill material on-site & off site	D	Surface water run-off	iv	Proposed Building
		E	Surface water percolation to groundwater	v	Groundwater (Secondary A Aquifer)
		F	Migration via groundwater		
		G	Vertical and lateral migration of soil gases		

10 RISK ASSESSMENT

The level of information provided by the Landmark report and historic Ordnance Survey maps, together with the other information within the report is considered suitable to provide the data for a satisfactory risk assessment for the site. While there will always be uncertainties due to known or unknown gaps in information it is considered that sufficient information is available to reduce those uncertainties to within acceptable limits for the nature of the site under review.

An asbestos survey of existing structures and infrastructure (as defined under Section 5(a) of the Control of Asbestos Regulations 2012) was beyond the brief of this report. The risk assessment has been undertaken on the basis that should asbestos be identified within buildings or infrastructure, these materials will be removed appropriately by licensed contractors and asbestos materials disposed of in accordance with legal requirements prior to demolition or other works in order to avoid contaminating soils at the site.

Sources	Potential pollutant	Receptor	Pathway	Hazard severity	Likelihood of occurrence	Risk / Significance	Comment & control measures
Car park, lock up garages, electricity substations, demolition debris & imported hard core	Metals Hydrocarbons PAHs, PCB	Residents & Site Users	Dermal contact	Medium	Likely	Moderate risk	Contamination testing
			Inhalation of vapours, indoors and outdoors	Mild	Low likelihood	Low risk	
			Soil Ingestion	Medium	Likely	Moderate risk	
			Inhalation of contaminated dust	Medium	Likely	Moderate risk	
			Drinking of water from supply impacted by contaminated soil	Mild	Low likelihood	Low risk	It is not considered that an upgraded water supply pipe is required, however it is recommended that this report is provided to the water supplier for their comment.

Sources	Potential pollutant	Receptor	Pathway	Hazard severity	Likelihood of occurrence	Risk / Significance	Comment & control measures
Car park, lock up garages, electricity substations, demolition debris & imported hard core	Metals Hydrocarbons PAHs, PCB	Construction operatives	Dermal contact	Mild	Likely	Moderate/Low risk	Information to be contained in site Health & Safety Plan. Use of appropriate ppe and normal good hygiene measures. Appropriate dust control measures during construction.
			Inhalation of vapours, indoors and outdoors	Minor	Low likelihood	Very low risk	
			Soil Ingestion	Mild	Likely	Moderate/Low risk	
			Inhalation of contaminated dust	Mild	Likely	Moderate/Low risk	
		Maintenance Operatives	Dermal contact	Mild	Low likelihood	Low risk	Information to be contained in site Health & Safety Plan.
			Inhalation of vapours, indoors and outdoors	Minor	Low likelihood	Very low risk	
			Soil Ingestion	Mild	Low likelihood	Low risk	
			Inhalation of contaminated dust	Mild	Low likelihood	Low risk	

Sources	Potential pollutant	Receptor	Pathway	Hazard severity	Likelihood of occurrence	Risk / Significance	Comment & control measures
Car park, lock up garages, electricity substations, demolition debris & imported hard core	Metals Hydrocarbons PAHs, PCB	Neighbours	Inhalation of vapours, indoors and outdoors	Minor	Unlikely	Very low risk	No further action required
			Inhalation of contaminated dust	Mild	Likely	Moderate/Low risk	Appropriate dust control measures during construction.
			Inhalation of contaminated dust (post construction)	Mild	Low likelihood	Low risk	Contamination testing
			Surface water run-off	Mild	Likely	Moderate/Low risk	
			Migration via groundwater	Mild	Likely	Moderate/Low risk	

Sources	Potential pollutant	Receptor	Pathway	Hazard severity	Likelihood of occurrence	Risk / Significance	Comment & control measures
Car park, lock up garages, electricity substations, demolition debris & imported hard core	Metals Hydrocarbons PAHs, PCB	Aquifer	Vertical percolation to groundwater via Foundations & Drainage	Mild	Likely	Moderate/Low risk	Foundations and drainage should be designed in such a way that they do not create a pathway for surface water percolation.
			Vertical percolation to groundwater via soft landscaped and permeable areas	Mild	Likely	Moderate/Low risk	Contamination testing

Sources	Potential pollutant	Receptor	Pathway	Hazard severity	Likelihood of occurrence	Risk / Significance	Comment & control measures
Unknown nature of fill material on-site & off site	Methane & carbon dioxide	Structures & other confined spaces	Migration via permeable strata & build up in buildings & other confined spaces	Severe	Likely	High risk	Ground gas monitoring to be undertaken. Gas protection measures installed if required. Information to be contained in site Health & Safety Plan.
		Construction & Maintenance Operatives		Severe	Low likelihood	Moderate risk	
		Residents & Site Users		Severe	Likely	High risk	
		Neighbours		Severe	Low likelihood	Moderate risk	
Demolition debris & imported hard core	Asbestos	Residents & Site Users	Inhalation (during construction)	Severe	Low likelihood	Moderate risk	Any debris from earlier demolition found during site strip is to be inspected for asbestos by a suitably experienced contractor.
		Construction operatives		Severe	Low likelihood	Moderate risk	
		Maintenance Operatives		Severe	Unlikely	Moderate/Low risk	Information to be contained in site Health & Safety Plan.
		Neighbours		Severe	Unlikely	Moderate/Low risk	Dust control during any ground works

Sources	Potential pollutant	Receptor	Pathway	Hazard severity	Likelihood of occurrence	Risk / Significance	Comment & control measures
Demolition debris & imported hard core	Asbestos	Residents & Site Users	Inhalation of contaminated dust (post construction)	Severe	Low likelihood	Moderate risk	Contamination testing
		Neighbours		Severe	Unlikely	Moderate/Low risk	
Naturally occurring contaminants, Car park, lock up garages, electricity substations, demolition debris & imported hard core	Sulphates, pH	Proposed Building	Direct contact of soil with building materials	Medium	Likely	Moderate risk	As the protection of concrete is normally resolved in the building design process, the designer of the foundations should determine the requirement to undertake any investigation.

Sources	Potential pollutant	Receptor	Pathway	Hazard severity	Likelihood of occurrence	Risk / Significance	Comment & control measures
Nearby commercial activity (Off Site)	Metals Hydrocarbons PAHs, PCB	Residents & Site Users	Lateral migration of groundwater transporting contaminants to soil/made ground on site	Medium	Low likelihood	Moderate/low risk	Contamination testing
		Construction & Maintenance Operatives		Mild	Low likelihood	Low risk	Information to be contained in site Health & Safety Plan.
		Residents & Site Users	Drinking water supply impacted by groundwater transporting contaminants to site	Medium	Low likelihood	Moderate/low risk	It is not considered that an upgraded water supply pipe is required, however it is recommended that this report is provided to the water supplier for their comment.