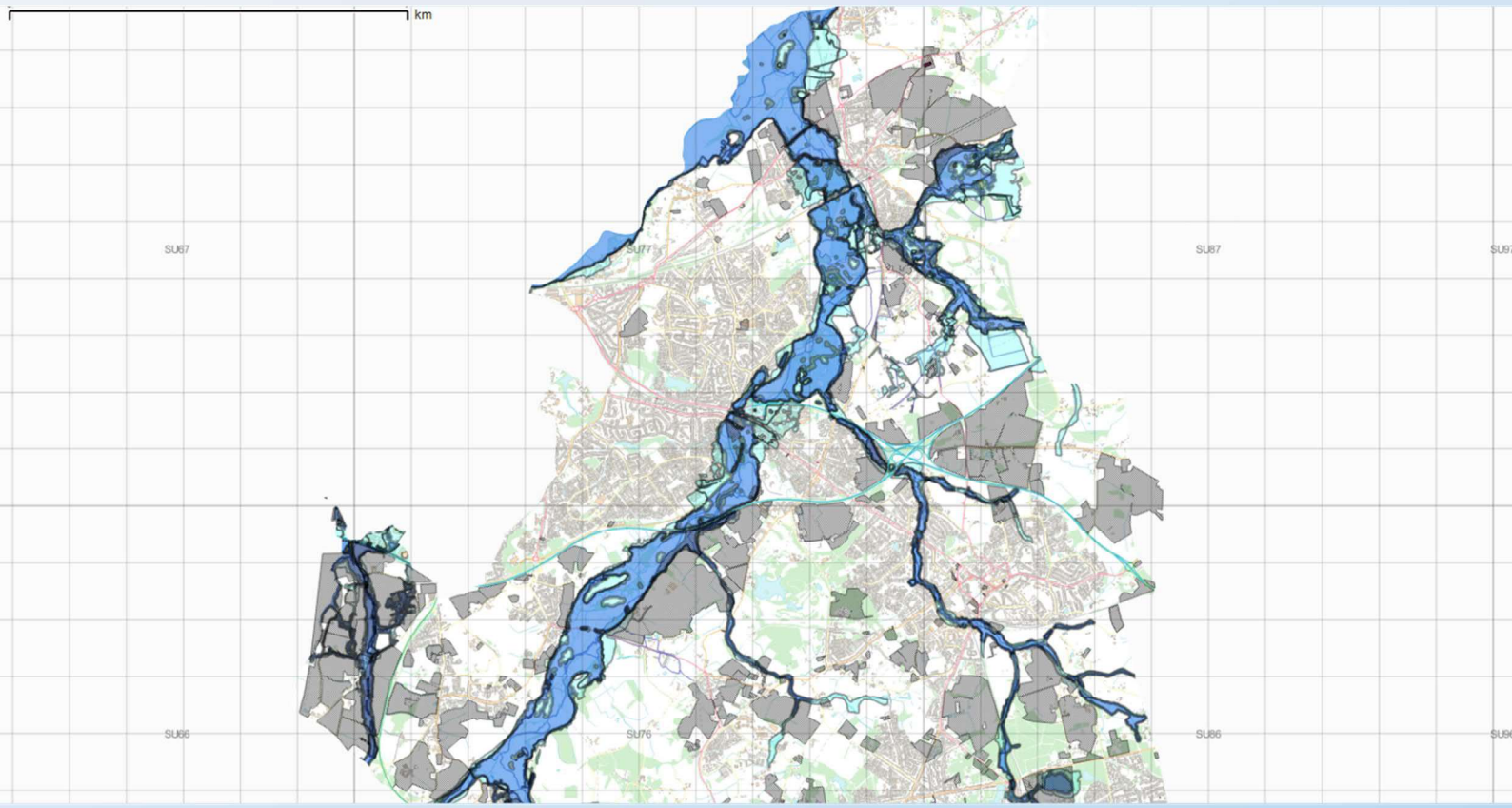
Wokingham Borough Council

STRATEGIC FLOOD RISK ASSESSMENT

Updated January 2020



Wokingham Borough Council

STRATEGIC FLOOD RISK ASSESSMENT

Updated January 2020

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EXECUTIVE SUMMARY

A Strategic Flood Risk Assessment (SFRA) assesses flood risk within a Local Planning Authority's (LPA) catchment area. The requirement to prepare a SFRA is set out in the National Planning Policy Framework (NPPF).

The purpose of a Level 1 SFRA is to collect sufficient information to enable a LPA to undertake the NPPF flood risk Sequential Test. The purpose of the Sequential Test is to assess potential development sites and rank them in order of least flood risk to highest. This information should then be used to assess, which (if any) allocation sites will be required to satisfy the Exception Test.

The first part is assessed by a Sustainability Appraisal, which will need to confirm if the Exception Test is passed and the second part of which is covered by a SFRA Level 2. This process seeks to prevent inappropriate development occurring within higher flood risk areas, where other lower risk sites are available.

Guidance for Local Planning Authorities that was last updated in August 2019 identifies that Level 1 SFRA maps should show the risk of flooding from the following:

- Rivers, sea and estuaries.
- Surface water.
- Reservoirs.
- Groundwater.
- Coastal erosion.
- Areas with a critical drainage problem.Areas where sewer capacity may be causing drainage issues and contributing to local flood risk.

Flooding from all sources considered in the NPPF needs to be included within the SFRA including:

- Tidal (coastal and estuarine) flooding.
- Fluvial (fluvial) flooding.
- Pluvial (rainfall) flooding.
- Sewer flooding.
- Groundwater flooding.
- Residual risk (failure of flood defences or large above ground water impoundments.

This report provides the above information including a data sheet for each Local Plan Update site and a Sequential Test.

The existing flood risk to the Borough catchment has been assessed through review of the data sources held by the Environment Agency (which include hydraulic model outputs), Wokingham Borough Council, and Thames Water. The SFRA identifies where there are significant areas of flood risk within the Borough from all sources, including fluvial, surface water, groundwater, sewer and drainage infrastructure.

The SFRA provides the background information on flood risk and flood risk policy that applies to the Borough, as well as the requirements for site-specific development proposals, land-use planning and flood risk mitigation. The SFRA also includes a high-level assessment of flood risk for 266 sites and site clusters, (as known at the time of writing) that will be considered for allocation in the Local Plan Update, as well as the methodology for applying the Sequential Test and the Exception Test for site-specific developments.

This SFRA was updated in October 2019, to take account of the latest version of the National Planning Policy Framework and Planning Practice Guidance. The report is a 'living document' and should be updated periodically to ensure it contains accurate flood risk information and reflects changes to flood risk policy and guidance.

1

INTRODUCTION

1. INTRODUCTION

1.1. PURPOSE OF THE SFRA

1.1.1. The National Planning Policy Framework 2019 (NPPF) requires that Local Planning Authorities (LPAs) prepare a Strategic Flood Risk Assessment (SFRA), in consultation with the Environment Agency. The primary purpose of the SFRA is to determine the variations in flood risk across the Borough. The Borough Extent is provided as Appendix A.1, the Parish Map is provided as Appendix A.2, and the Local Plan Update (LPU) Sites Distribution is provided as Appendix A.3.

1.1.2. This SFRA for Wokingham Borough Council has been prepared with specific reference to the *Local Planning Authorities: strategic flood risk assessment guidance*[1]. The guidance requirements and the associated section of the report covering the requirement is summarised in Table 1.

[1] https://www.gov.uk/guidance/local-planning-authorities-strategic-flood-risk-assessment#level-1-strategic-flood-risk-assessment

Table 1: LPA SFRA Guidance

Requirement	Detail	Report Location
Mapping	Main rivers	Appendix A.4
	Any other rivers, streams and any other significant bodies of water	Appendix A.4
	Development sites that have been allocated in the Local Plan as well as sites under consideration for future allocation in the local plan	Appendix A.3
	Flood zones including the functional floodplain (land where water has to flow or be stored in times of flooding) if there is one	Appendix A.5
	Any land safeguarded from development that is required for current and future flood management main rivers	Section 4.4
Assessment	Map areas at risk from other sources of flooding	Section 4.1, and 4.2
	List existing measures (for example, flood gates, flood defence assets) to manage flood risk – state where they are and what standard of flood protection they provide	Section 4.3
	List areas that are covered by flood warnings	Section 4.5
	Map any area with critical drainage problems as notified by the Environment Agency	Section 4.6
Advice for applicants	Requirements for a site -specific FRA	Section 6
	Make it clear what the requirements are in particular locations to assess and manage flood risk	Section 6
	Advice on the use of sustainable drainage (SuDS) techniques in certain locations.	Section 7 WBC has published guidance on the design of SuDS within the Borough.

1.1.3. Robust information on flood risk is essential to inform and support Wokingham Borough Council's revised flooding policies in its LPU. The SFRA is a technical document and forms part of the evidence base for the LPU.

1.1.4. SFRAs should be owned as 'living documents', which are reviewed and updated on a regular basis as a result of emerging policy directives and an improved understanding of local flood risk. Wokingham Borough Council's initial SFRA was completed in July 2007. The document was updated in February 2012, to ensure the document continued to contain the latest flood risk information and reflected updates to policy and guidance since the previous SFRA. The 2012 update also included individual flood risk analysis of the proposed development allocations in the Borough.

1.1.5. This update to the SFRA was necessary due to a number of updates and changes to flood risk policy and legislative documents. This included the replacement of Planning Policy Statement 25 with the NPPF in March 2012, the 2018 and 2019 NPPF updates and the development of the Borough's own LPU. Wokingham Borough has also experienced a number of flooding events since 2012, with the most significant of these events occurring in winter 2013/14. There is therefore, additional flood risk evidence that has been included in this SFRA.

1.1.6. This SFRA is a strategic investigation that is intended to provide an overview of flood risk throughout the Borough, providing the framework within which future planning decisions (including development applications) are to be reviewed. For a specific proposed development site, a more detailed Flood Risk Assessment (FRA) may be required depending on the level of flood risk (see Chapter 6). This FRA would be carried out at the planning stages by the developer/applicant.

1.1.7. This report sets out our findings in relation to flood risk in the Borough. The SFRA makes use of existing flood risk data and knowledge within the Borough. This has been sourced through consultation with the Environment Agency, Wokingham Borough Council, Thames Water, Local Town and Parish Councils and Residents Associations.

1.1.8. This report contains the outcomes of the SFRA process; the collation and analysis of information relating to flood risk posed to the Borough from rivers, surface water, groundwater and large reservoirs/lakes and sewers. It also includes the delineation of Wokingham into zones of 'high', 'medium' and 'low' probability of flooding in accordance with the NPPF.

1.1.9. This SFRA will inform the allocation of sites for possible future development. Individual flood risk information has been summarised for over 266 potential allocation sites or clusters of sites that will be considered for allocation in the emerging LPU. The SFRA also includes guidance on FRAs and sustainable drainage systems (SuDS), along with several recommendations for development management and emergency planning (community resilience).

1.2. STUDY AREA

1.2.1. Wokingham Borough Council is a Unitary Authority in Berkshire, South East England. Appendix A.2 provides a map of the Parishes that form the Borough.

1.2.2. Appendix A.3 presents a map of the distribution of the LPU sites reviewed as part of this SFRA and provides the LPU reference and the related street address. This information has been reported from geo-spatial data provided by Wokingham Borough Council. The LPU references are used throughout this report. A full list of the individual LPU Sites assessed is provided at Table 2 and where sites have been grouped this is provided as Table 3.

1.2.3. The four Sites of Special Scientific Interest (SSSI) within the Borough (Stanford End Mill and River Loddon, Longmoor Bog, Heath Lake and Lodge Wood & Sanford Mill) support water dependent habitats and therefore, are reliant on the retention of a high-water table and/or periodic flooding to retain their value. Any proposals which have the potential to impact these important features must be robustly tested.

Table 2: Single LPU Sites Considered in this SFRA

No.	LPU Reference	Site Size (Ha)	Address
1.	5AR001	4.27	Land to the north of Reading Road
2.	5AR002	3.48	Cloud Stables, Church Lane
3.	5AR003	0.85	Land at Church Lane
4.	5AR004	0.58	Land at Reading Road
5.	5AR005	1.21	Ridgefield Farm, Reading Road
6.	5AR006	1.40	Land on south side of Reading Road
7.	5AR011	3.25	Land off Betty Grove Lane
8.	5AR013	1.31	Land to the rear of The Copse, Eversley Road
9.	5AR014	10.57	Land west of Mole Road
10.	5AR015	244.08	Land at Arborfield
11.	5AR016	0.10	Land adjoining Hunters Point, Hughes Green
12.	5AR020	13.87	Lockey Farm, Sindlesham Road
13.	5AR023	0.27	Redwood
14.	5AR024	2.71	Land to the south Bridge Farm Business Park
15.	5BA002	1.14	Land at Barkham Manor
16.	5BA003	0.43	Land at Suncot, School Road
17.	5BA004	4.58	The Bungalow, Edney Hill
18.	5BA006	0.80	Land to the rear of 326-334, Barkham Ride
19.	5BA008	2.05	Land off Barkham Street
20.	5BA009	5.93	Model Farm, Barkham Ride
21.	5BA010	58.40	Barkham Square
22.	5BA011	0.41	Land to the rear of 320 – 384 Barkham Road

23.	5BA012	10.30	Reading Football Club Training Ground, Hogwood Park, Park Lane
24.	5BA016	6.21	Willow Farm, School Road
25.	5BA017	0.84	Land adjacent to Coppid Hill House, Barkham Road
26.	5BA018	11.21	Land at Highland Avenue
27.	5BA019	1.13	Wrens Nest Stables, Barkham Road
28.	5BA024	0.51	Land to North of the Shires
29.	5BA025	0.81	29 Bearwood Road
30.	5BA026	1.13	Land north of Barkham Road
31.	5BA027	5.22	Land to the rear of 178 Bearwood Road
32.	5BA029	0.42	Land at Suncot
33.	5CV001	13.32	Land east and west of Park View Drive North
34.	5CV002	8.82	Land West of Park Lane
35.	5CV004	0.30	3 Norris Green
36.	5CV005	1.39	Land to the rear of Oaktree Cottage
37.	5EA001	0.81	Land at Lower Earley Way, Danehill, Cutbush Industrial Park
38.	5EA002	2.30	Gasholders
39.	5FI001	2.05	Tintagel Farm
40.	5FI002	0.92	Heartwood Lodge
41.	5FI003	5.42	31 and 33 Barkham Ride
42.	5FI004	9.03	Greenacres Farm, Nine Mile Ride
43.	5FI005	3.25	Silverstock Manor
44.	5FI007	0.64	Land to the rear of 5 Clayside
45.	5FI009	5.24	Land at Sandhurst Road
46.	5FI010	5.05	Land to the East of Finchampstead Road
47.	5FI012	2.93	Land Opposite Hall Farm, Lower Sandhurst Road
48.	5FI013	10.90	Land West of Finchampstead, Longwater Lane
49.	5FI014	0.15	Land to the rear of 6-8, The Village

50.	5FI015	0.59	Land to the rear of 166 Nine Mile Ride
51.	5FI016	0.37	Broughton Farm, Heath Ride
52.	5FI017	4.50	Paddock Farm, Nine Mile Ride
53.	5FI018	1.34	Land to the rear of No. 6 Johnson Drive
54.	5FI019	2.10	Land to the rear of 267 and 273 Finchampstead Road
55.	5FI021	0.91	Land to the rear of 76 & 80a Reading Road
56.	5FI022	0.74	Land at Horns Farm, Reading Road
57.	5FI023	0.58	Land to the South of Reading Road
58.	5FI024	0.79	Jovike, Lower Wokingham Road
59.	5FI025	16.23	Land North of Nine Mile Ride
60.	5FI026	0.48	Land Adjacent to 294 Nine Mile Ride
61.	5FI027	0.73	Land lying to the rear of 115 - 137 Nash Grove Lane
62.	5FI028	2.54	Westwood Cottage, Sheerlands Road
63.	5FI029	2.38	The Ridges
64.	5FI030	0.74	Bluebell Farm, Commonfield Lane
65.	5FI031	1.97	Land at Sandhurst Road
66.	5FI032	0.70	Honey Suckle Lodge, Commonfield Lane
67.	5FI039	17.86	Land at Bulloways Farm Land, Eversley
68.	5FI040	2.01	Land at Great Oaks, Fleet Hill
69.	5FI041	5.36	Land West of Finchampstead Road
70.	5FI042	0.87	Land on North Side of Reading Road
71.	5FI045	1.18	Land at The Rear of 238-240 Nine Mile Ride
72.	5FI046	8.93	Land east of Wokingham Road, and south of Duke's Ride (Derby Field)
73.	5FI047	2.30	Land at Longwater Road
74.	5FI048	12.79	Park Farm
75.	5HU001	1.95	Little Hill Road
76.	5HU002	0.37	Land adjacent to Whistley Green Cottage, Whistley Green

77.	5HU003	18.29	Whistley Meadow St Nicholas, Whistley Green
78.	5HU004	4.50	Land at Broadcommon Road
79.	5HU005	1.92	Land at The Phoenix, Nelson's Lane
80.	5HU006	1.12	Land on the North Side of Orchard Road
81.	5HU007	0.37	Land at St Swithins Cottage, Hinton Road
82.	5HU008	0.78	Land off Lodge Road
83.	5HU016	10.58	Land on the east side of Lodge Road
84.	5HU018	0.21	Land north west side of Nelsons Lane
85.	5HU019	0.50	Land To The South Of Units 1 To 12 Beech Court, Wokingham Road
86.	5HU025	1.55	Hedgerley Stables
87.	5HU026	0.29	Hedgerley Stables
88.	5HU027	1.06	Walden Acres, Wokingham Road
89.	5HU028	1.88	West Lodge strip of land North and South, Lodge Road
90.	5HU029	0.30	Triangle outside Hurst House
91.	5HU030	4.04	Land north-west of Hogmoor Lane
92.	5HU031	2.41	Land south-west of Broadwater Lane
93.	5HU032	2.06	Land southwest of Broadcommon Road
94.	5HU034	17.81	Land west of Dunt Lane and south of Green Lane
95.	5HU035	4.45	Heriots, Wokingham Road
96.	5HU037	18.17	Dinton Pastures, Sandford Lane, Davis Street, Hurst, RG10 0SU
97.	5HU040	0.37	Galtimore, Dunt Lane, Hurst
98.	5HU042	0.12	Land at Junction of Davis Street and Dunt Lane
99.	5HU043	12.29	Land to the west of Hurst Road
100.	5HU044	0.89	Land between Davis Way & Little Hill Road
101.	5HU046	0.52	Douglas House, Douglas Way
102.	5HU048	1.19	Hatch Farm Gate
103.	5HU049	1.12	Stokes Cottage

104.	5HU050	0.65	Land adjacent to Old Crown Cottage
105.	5RU001	42.17	Land to the west of London Road
106.	5RU002	13.30	Land north of Castle End Road
107.	5RU003	6.64	Land east of Church Lane
108.	5RU004	43.52	Land at Southbury Lane
109.	5RU005	37.60	Land to the east of London Road
110.	5RU006	89.20	Land at Ruscombe
111.	5RU007	0.51	Land to the rear of 9-17 Northbury Lane, Ruscombe
112.	5RU008	0.86	Land between 39-53 New Road, Ruscombe
114.	5SH001	2.99	Land adjacent to North Lodge, Basingstoke Road
115.	5SH002	4.34	Land west of Basingstoke Road
116.	5SH003	0.82	The Paddock, Croft Lane
117.	5SH005	1.28	Derydene, Basingstoke Road
118.	5SH006	3.71	Land off Winston Close
119.	5SH007	0.74	Land off Sussex Lane
120.	5SH008	0.29	Land between Orchard House, Sunways and Greenfields, Croft Road
121.	5SH009	0.85	Land Adjacent to East side of Oakbank School
122.	5SH010	4.14	Land at Grazeley Road
123.	5SH011	0.34	Lane End House, Shinfield Road
124.	5SH012	0.22	Land at Cutbush Lane
125.	5SH013	38.63	Body's Farm, Basingstoke Road
126.	5SH014	4.22	Land off Sussex Lane
127.	5SH015	5.62	Land at Stanbury House, Basingstoke Road
128.	5SH016	13.50	Land at Three Mile Cross, Church Lane
129.	5SH017	35.50	Land at Highlands
130.	5SH018	1.68	Lane End Villas
131.	5SH019	4.69	Parklands, Basingstoke Road

132.	5SH021	4.24	Land at Kirtons Farm Road
133.	5SH022	1.63	Land at The Manor, Church Lane
134.	5SH023	6.54	Land east of Hyde End Road
135.	5SH024	7.29	Land north west side Church Lane
136.	5SH025	16.43	Land South of Cutbush Lane
137.	5SH026	2.53	Land South of Millworth Lane
138.	5SH027	3.94	Land West of Hyde End Road
139.	5SH030	0.29	Rose Cottage, Croft Road
140.	5SH031	0.34	Rustlings', 'The Spring' and land to the rear of 'Cushendall', Shinfield Road
141.	5SH032	0.74	Land to the rear of Diana Close
142.	5SH033	4.14	Land at Grazeley Road
143.	5SH035	33.34	Land at Highlands, Basingstoke Road
144.	5SH042	4.34	Land at Basingstoke Road, Spencers Wood
145.	5SH043	1.11	Land to the north of Brookers Hill
146.	5SH044	2.56	Dobbies Garden Centres Limited
147.	5SH045	0.47	18 Sevenoaks Drive, Spencers Wood
148.	5SH046	0.30	Land at Stanbury Park, Spencers Wood
149.	5SH049	5.54	Shinfield Grange
150.	5SH051	2.29	Land at Church Lane
151.	5SH052	29.30	Land east of Thames Valley Science Park
152.	5SH053	0.50	Oakwood, Croft Road
153.	5SO001	1.37	Land at Sonning Farm
154.	5SO002	6.26	Land east of Garde Road
155.	5SO003	3.66	Land North of Thames Street
156.	5SO004	9.11	Land West of Milestone Avenue
157.	5SO005	0.75	Land at Sonning Golf Club, Duffield Road
158.	5SO007	0.20	Land Adjacent to Model Farm Cottages Bath Road

113.	5SO008	1.34	Sonning Golf Club
159.	5SO009	3.10	Thatched Cottage
160.	5SW001	1.68	Land on the North East side of Part Lane and the South West side of Church Road, Part lane
161.	5SW002	1.39	Land at Basingstoke Road
162.	5SW003	1.66	Land adjoining The Lodge, Taylors Lane
163.	5SW004	28.28	Land off Basingstoke Road
164.	5SW005	5.68	Site bounded by Trowes Lane (to the east) and Oakleigh Farm (to the west)
165.	5SW006	3.84	Land off Basingstoke Road
166.	5SW007	1.41	Land south of The Street and west of Trowes Lane
167.	5SW008	0.06	Arkley, Lambs Lane
168.	5SW009	4.67	Land adjacent to Applegarth Basingstoke Road
169.	5SW010	3.85	Land South of Part Lane
170.	5SW011	1.94	Land at Bull Lane
171.	5SW012	1.69	Land at Part Lane
172.	5SW013	1.64	Land Adjoining Lambs Farm Business Park
173.	5SW015	40.80	Loddon Court Farm, Beech Hill Road
174.	5SW016	3.39	Land adjacent Oakleigh Farm, Part Lane
175.	5SW017	0.96	Uplands and Land Adjacent to uplands, Basingstoke Road, Swallowfield.
176.	5SW018	1.31	Land to the east of Basingstoke Road and south of The Street
177.	5SW019	4.22	Land to the north of Charlton Lane and west of Trowes Lane
178.	5SW020	2.91	Land north of Part Lane, Riseley
179.	5SW021	0.97	Land at Swallowfield
180.	5TW005	7.20	Land at Bridge Farm
181.	5TW006	2.62	Land West of Hurst Road
182.	5TW007	23.97	Land north of the A4

183.	5TW008	0.40	134 Wargrave Road
184.	5TW009	5.35	Land west of Twyford
185.	5TW010	12.23	Land at Bridge Farm
186.	5TW011	23.97	Land north of A4 New Bath Road and west of A321 Wargrave Road
187.	5WA002	3.61	Hare Hatch Sheeplands
188.	5WA003	2.12	Primrose Nursery
189.	5WA004	3.10	Land to the south of Bath Road
190.	5WA005	2.31	Land west of Wargrave Road and north of the A4 New Bath Road
191.	5WA006	1.35	Land at the Eastern end of 'The Old House'
192.	5WA007	2.32	Primrose Nursery
193.	5WA008	3.71	Hare Hatch Garden Centre, Floral Mile, Hare Hatch.
194.	5WA009	0.55	Land adjoining Bear Cottage, Milley Lane, Hare Hatch, RG10 9TL
195.	5WA010	2.31	Land west of Wargrave Road and north of the A4 New Bath Road
196.	5WI001	1.48	Land at Hatch Farm
197.	5WI002	1.28	Land at Hatch Farm
198.	5WI003	0.10	498 Reading Road
199.	5WI005	5.33	Winnersh Garden Centre, Reading Road
200.	5WI006	11.21	Land off Maidensfield
201.	5WI007	59.26	Home Farm, Bearwood Road
202.	5WI008	1.59	Winnersh Plant Hire
203.	5WI009	4.19	Land on the North West Side of Old Forest Road
204.	5WI010	6.79	Winnersh Farm Watmore Lane
205.	5WI011	0.73	Wheatsheaf Close
206.	5WI012	2.19	Winnersh Allotments, Reading Road, Wokingham, RG41 5AG
207.	5WI013	2.97	Millennium Arboretum, to rear of properties at 22-28 Wayside, off Old Forest Road, Wokingham, RG41 1

208.	5WI014	1.25	69 King Street Lane
209.	5WI015	32.76	Hatch Farm
210.	5WI017	1.07	Holmewood House
211.	5WK002	17.91	Ashridge Farm, Warren House Road
212.	5WK006	3.87	Land South of Gipsy Lane
213.	5WK008	0.17	Ritz Plaza House, Easthampstead Road
214.	5WK009	4.51	Wokingham STW, Bell Foundary Lane
215.	5WK011	0.79	Land South of London Road (Western Field)
216.	5WK012	0.43	54 - 58 Reading Road
217.	5WK013	0.32	Land at Toutley Road
218.	5WK015	0.14	Exa House, Elms Road
219.	5WK017	0.44	Telephone Exchange, Elms Road
220.	5WK018	0.30	54 - 72 Peach Street
221.	5WK019	1.47	Carnival Pool Phase 2, Wellington Road
222.	5WK021	0.22	Land at the Bowers
223.	5WK023	0.73	Rosery Cottage and 171 Evendons Lane
224.	5WK025	0.79	Old Forest Road
225.	5WK026	8.98	Land adjoining Berkshire Way
226.	5WK028	29.66	Land at Blagrove Lane
227.	5WK029	0.65	Station Industrial Estate, Oxford Road
228.	5WK030	1.75	Millars Business Park, Molly Millars Lane
229.	5WK032	6.14	Land to north of Doles Lane
230.	5WK033	0.06	Land adjacent to 229 Barkham Road
231.	5WK034	17.53	Land to the east and west of Blagrove Lane
232.	5WK035	0.60	West Forest Gate, Finchampstead Road
233.	5WK036	0.87	Land at the rear of Chapel Green House
234.	5WK037	24.37	Land east of Finchampstead Road
235.	5WK038	65.34	Land at Woodcray Manor

236.	5WK039	3.44	Land fronting Barkham Road
237.	5WK040	4.01	Ten Acres Farm
238.	5WO002	2.55	Western Site, Headley Road East
239.	5WW001	0.60	Land between Pinewood Villas and St Michael's Cottages, Old Wokingham Road
240.	5WW003	6.52	Pine Ridge Park, Nine Mile Ride
241.	5WW004	31.60	Birchin Inhams Farm, Heathlands Road
242.	5WW005	0.05	Old Sawmill Lane
243.	5WW006	25.98	Grays Farm, Heathlands Road
244.	5WW009	47.64	Ravenswood Village
245.	5WW010	2.04	Land Adjacent to Sulby Court, Heathlands Road
246.	5WW011	4.01	Heathlands Garden Centre, Heathlands
247.	5WW012	0.08	Heathlands, Land to the East of Heathlands Road
248.	5WW013	2.85	Pinecopse, Nine Mile Ride
249.	5WW014	4.17	Land at Heathlands, Nine Mile Ride
250.	5WW015	6.87	Land adjoining Bigwood House, Waterloo Road
251.	5WW016	6.87	Land adjacent to Bigwood House, Waterloo Road
252.	5WW017	1.16	Land East of Pearces Farm, Easthampstead Road
253.	5WW018	39.67	Heathlands Farm
254.	5WW019	6.14	Holme Grange Farm
255.	5WW020	11.69	Land west of Holme Grange Farm
256.	5WW022	0.56	Land south of Oaklands Lane, Crowthorne
257.	5WW023	6.41	Holme Park Grange

Table 3: Grouped LPU Sites

Grouped Name	Sub Sites included in Grouping
5HU015	5HU009, 5HU010, 5HU011, 5HU012, 5HU013, 5HU014, 5HU017, 5HU020, 5HU021, 5HU022, 5HU023, 5HU041, 5HU047,
5SH040	5SH029, 5SH041, 5SH047, 5SH048
5WI004	5WI016
5HU024	5HU033, 5HU039, 5HU045
5FI008	5FI020, 5FI038, 5FI049
5BA013	5AR007, 5AR008, 5AR009, 5AR010, 5AR012, 5AR018, 5AR021, 5BA014, 5BA015, 5BA028, 5BA030
5WW002	5WW021
5SH020	5SH050
5WK022	5WK041

1.2.4. A number of rivers and watercourses run through Borough including the River Thames, its tributary the Foudry Brook, the River Loddon and its tributaries the Twyford Brook, Emm Brook, Barkham Brook and the River Blackwater (refer to Appendix A.4). As severe flooding represents a risk to both property and life, it is essential that planning decisions are informed and take due consideration of the flood risk posed to, and potentially by, future development.

2

NATIONAL POLICY CONTEXT

2. NATIONAL POLICY CONTEXT

2.1.1. The principal guidance document for SFRAs is the National Planning Policy Framework (NPPF)[2]. The initial version published in March 2012 was replaced in July 2018, while the current version was updated in February 2019. This SFRA is consistent with the relevant policies from the NPPF 2019. The NPPF is supported by a number of Planning Practice Guidance (PPG) documents, including the Flood Risk and Coastal Change PPG, which provides additional guidance on the preparation of SFRAs.

2.1.2. The Flood Risk and Coastal Change PPG (March 2014) states that a local authority should use a SFRA to apply a risk-based approach to development, by applying the Sequential Test to potential site allocations. Where the Sequential Test is unable to deliver a sufficient number of sites to meet planning requirements, the Exception Test should be applied to potential development sites with higher vulnerability and/or flood risk.

2.1.3. In addition to the NPPF, several other national policies, legislation and guidance have emerged, which are relevant to SFRAs and the Council's responsibilities in respect to flood risk.

2.1.4. In February 2016 (last updated February 2019) the Environment Agency published advice on assessing climate change; Flood Risk Assessments: Climate Change Allowances. This updated previous climate change allowances to ensure flood risk is managed over the development's lifetime.

2.1.5. The Flood and Water Management Act 2010 was introduced to improve flood risk management and support the continuity of water supply. A key feature of the Act is the implementation of recommendations from the Pitt Review into the summer 2007 flooding, thus increasing the emphasis on sources of flooding other than fluvial and tidal. In particular surface water, which featured significantly in the 2007 flooding. The Act impacted Wokingham Borough, as a Lead Local Flood Authority (LLFA), with new responsibilities and powers with regard to local flood risk. This included surface runoff, groundwater and ordinary watercourses (including lakes and ponds).

2.1.6. The Flood Risk Regulations 2009 converted the EU Floods Directive into UK law. In accordance with the Regulations, Wokingham Borough Council has a duty to carry out a Preliminary Flood Risk Assessment (PFRA). The PFRA is a high-level screening exercise looking at readily available flood risk information and determining flood risk areas of national significance. Information from the SFRA will be used to inform the PFRA and vice-versa.

2.1.7. Catchment Flood Management Plans (CFMPs) set out the Environment Agency's policies on managing flood risk now and in the future. CFMP policies are designed based on river basins to achieve a holistic, sustainable approach to flood risk management. Wokingham Borough lies within the Thames CFMP region, which sets out policies relating to flooding from rivers, surface water and groundwater within the River Thames catchment area.

[2] The NPPF can be viewed on the Communities and Local Government website at https://www.gov.uk/government/publications/national-planning-policy-framework--2

3

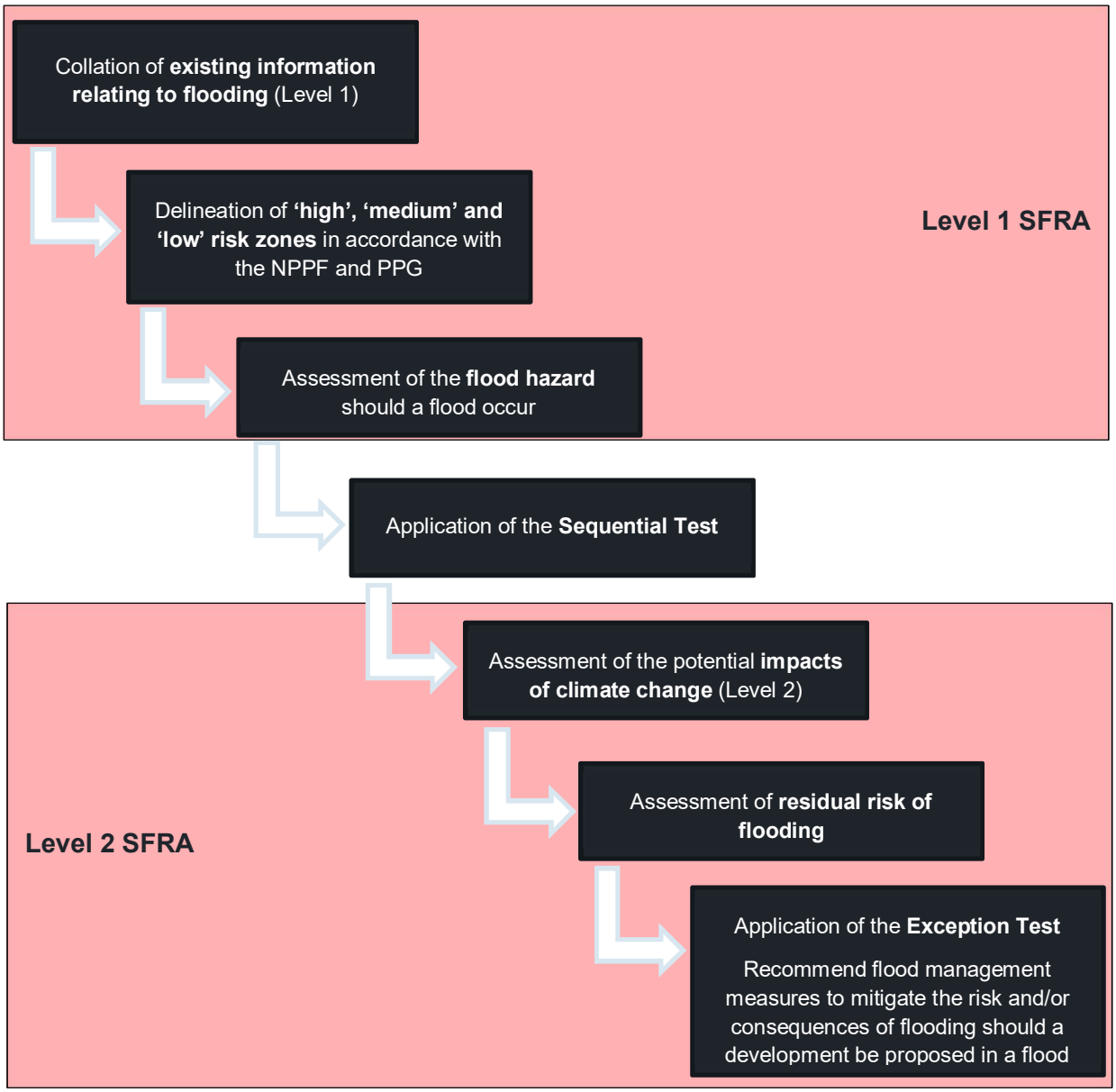
STRATEGIC APPROACH TO FLOOD RISK MANAGEMENT

3. STRATEGIC APPROACH TO FLOOD RISK MANAGEMENT

3.1. APPLICATIONS OF THE SFRA

3.1.1. The SFRA forms part of the development planning process for LPAs by collating information on flood risk and providing guidance based on assessment of this information. Figure 1 illustrates the components of each level of the SFRA and how they inform the planning process. This SFRA has been developed in accordance with the guidance in the NPPF, Flood Risk and Coastal Change PPG, 'How to prepare a strategic flood risk assessment' guidance and in consultation with the Environment Agency.

Figure 1: The SFRA Process



3.1.2. It should be noted that a Level 2 SFRA can only undertake a high-level review of a site's potential to pass the Exception Test. As outlined in the NPPF, a site-specific Flood Risk Assessment (FRA) is required in order to satisfy the requirements of the Exception Test. Any site allocations requiring the Exception Test will need to demonstrate compliance with the Exception Test, as part of the site's planning application.

3.1.3. In addition to its role in assisting the development management process, the SFRA also provides guidance on:

- The preparation of FRAs for allocated development sites (refer to Chapter 6).
- The likely applicability of sustainable drainage system (SuDS) techniques for managing surface water runoff (refer to Chapter 7).
- Community resilience measures, including flood warnings, safe access/egress, floor levels and building construction (refer to Chapter 6).

3.2. ALLOCATING DEVELOPMENT USING THE RISK BASED APPROACH

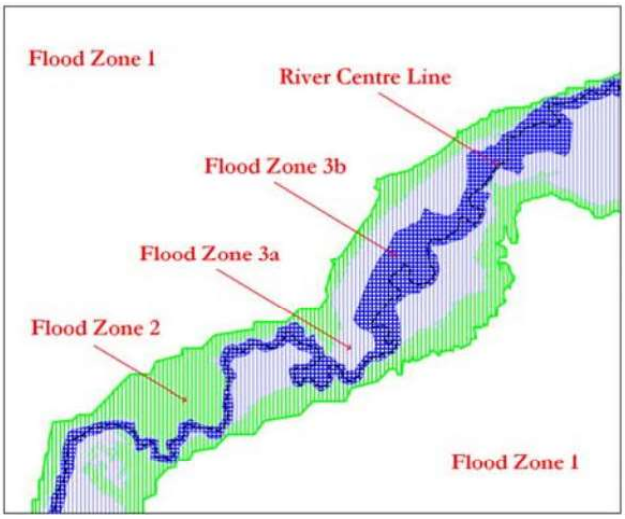
DELINEATING THE NPPF FLOOD ZONES

3.2.1. The risk of a flood event is a function of both the occurrence probability and the consequence to the community as a direct result of the flood.

3.2.2. The NPPF classifies different probability thresholds into flood zones. These classifications are low, medium and high probability flood zones, the latter including the functional floodplain (i.e. Flood Zones 1, 2, 3a and 3b respectively). An illustration of flood zones is shown in Figure 2. The NPPF provides mechanisms to ensure the consequences of flooding are managed sustainably.

3.2.3. Mapping the flood zones across the Borough is a key outcome of the SFRA process. The flood maps can then be used to inform the application of the Sequential Test and Exception Test and one of the key approaches to ensuring that development planning takes flood risk into account. This process focuses primarily on fluvial flooding, since this currently has the most robust evidence for determining flood risk, based on the use of flood zones. However, other sources of flooding should be taken into account as much as possible based on available information.

Figure 2: Fluvial Flood Zones



3.2.4. The flood zones into which the Borough has been delineated are summarised as follows:

FLOOD ZONE 1: LOW PROBABILITY

3.2.5. This flood zone comprises land located outside of the 0.1% Annual Exceedance Probability (AEP) fluvial flood extent.

3.2.6. For the purposes of the SFRA, this incorporates all land that is outside of Flood Zone 2, 3a and 3b, as defined below.

3.2.7. It is important to consider the flood risk to areas surrounding land classified as Flood Zone 1. Areas surrounded by flood water for a considerable amount of time can be considered as 'dry islands'. Although water ingress does not present a direct risk to life and/or property in these areas, residents may not be able to access food, water, medical care or utilities (e.g. electricity, sewerage and telephone) during times of flooding. Any future development within these areas must consider emergency responses during times of flood.

3.2.8. Developments at the edge of Flood Zone 1 may see an increased flood risk over time, due to the predicted impacts of climate change on river flows within the Borough.

FLOOD ZONE 2: MEDIUM PROBABILITY

3.2.9. Flood Zone 2 comprises land situated between the 0.1% and 1% AEP fluvial flood extents.

3.2.10. This SFRA uses the Environment Agency Flood Zone Map to define Flood Zone 2 Medium Probability.

FLOOD ZONE 3A: HIGH PROBABILITY

3.2.11. Flood Zone 3a is defined as those areas of the Borough that are situated within the 1% AEP fluvial flood extent.

3.2.12. The flood outlines for Flood Zone 3a as used in this SFRA are reflected in the current Environment Agency Flood Maps for Planning.

FLOOD ZONE 3B: THE FUNCTIONAL FLOODPLAIN

3.2.13. This flood zone comprises land where water has to flow or be stored in times of flood. LPAs should identify in their SFRAs areas of functional floodplain in agreement with the Environment Agency. The NPPF PPG[3] states the following:

> *The identification of functional floodplain should take account of local circumstances and not be defined solely on rigid probability parameters. However, land which would naturally flood with an annual probability of 1 in 20 (5%) or greater in any year, or is designed to flood (such as a flood attenuation scheme) in an extreme (0.1% annual probability) flood, should provide a starting point for consideration and discussions to identify the functional floodplain.*

3.2.14. For the purposes of this SFRA, Flood Zone 3b Function Floodplain has been defined as:

- Land subject to flooding in the 5% AEP fluvial flood event, excluding building footprints; and,
- Land which provides a function of flood conveyance (i.e. free flow) or flood storage, either through natural processes, or by design (e.g. washlands and flood storage areas).

[3] Paragraph: 015 Reference ID: 7-015-20140306

3.2.15. Detailed modelled flood extents for the 5% AEP design event were adopted for the Main Rivers in the Borough as the basis of Flood Zone 3b Functional Floodplain delineation. In areas where the 5% AEP flood event has not been identified in the SFRA, a precautionary approach should be applied, assuming that all of the 1% AEP flood extents is the functional floodplain, until the coverage of the 5% AEP flood extents is adequately demonstrated by a site-specific FRA.

FLOOD DEFENCES

3.2.16. It should be noted that typically Flood Zones 2 and 3a do not take account of the presence of flood defences. In terms of planning policy this is a conservative assumption, meaning that new development placed in accordance with the Sequential Test would not rely on the presence of flood defences, as there remains a risk that these defences can fail through overtopping or structural failure.

3.2.17. Definition of Flood Zone 3b is more flexible and dependent on local agreement between each council and the Environment Agency. In some cases, it may be appropriate to take defences into account since these will affect where water is able to flow or be stored in times of flood and thus, which land is vulnerable to flooding in reality.

3.3. ASSESSMENT OF FLOOD HAZARD

3.3.1. Of equal importance to the maximum extent to which flooding will occur during a particular flood event (i.e. the probability of an area experiencing flooding), is the flood hazard (i.e. the speed and depth with which flooding occurs as water levels rise).

3.3.2. Flood hazard is used to give an indication of the risk to life posed by flood water. The severity of flood hazard depends on water depth and velocity, along with an additional degree of hazard arising from debris in the water. This reflects the danger to a person from a combination of deep and fast flowing water. The combination is important since if the water is fairly deep but not moving, a person may normally still be able to walk safely through it. However, in deeper water a person would find walking difficult, at which point the level of risk greatly increases. Conversely, shallow but fast flowing water (high velocity) may unbalance a person and thus also pose a danger.

3.3.3. To ensure that the risk posed by floodwaters is assessed consistently, Defra (in collaboration with the Environment Agency) has produced a Flood Hazard equation. The guidance documents '*FD2321 Flood Risks to People*' and '*FD2320 Flood Risk Assessment Guidance for New Development TR1 and TR2*' and the additional supplementary Note[4] provide further details on the equation and how it should be applied.

3.3.4. The Flood Hazard equation provides criteria for determining the degree of danger that is posed to life, assessed as a product of flood depth and flow velocity with an additional 'debris factor':

Depth x (Velocity + 0.5) + Debris Factor

3.3.5. Depending on the flood hazard value calculated, the severity of the hazard is indicated by the class into which the value falls, which are shown in Table 4.

[4] Environment Agency and HR Wallingford (2008) Supplementary Note on Flood Hazard Ratings and Thresholds for Development Planning and Control Purpose

Table 4: Flood Hazard Classifications

Flood Hazard Rating	Hazard to People Classification
Less than 0.75	Very low hazard – Caution
0.75 to 1.25	'Danger for some' – includes children, the elderly and the infirm
1.25 to 2.00	'Danger for most' – includes the general public
More than 2.00	'Danger for all' – includes emergency services

3.3.6. Flood hazard results are sometimes produced where detailed 2D hydraulic modelling has been carried out, particularly if a breach of flood defences is being investigated. Whilst the River Loddon and River Blackwater have 2D modelling available, flood hazard results are not directly available, but it is possible to compile them retrospectively based on the depth and velocity results. However, in this case a tiered debris factor is not possible and thus a conservative value of 1.0 has been applied in all cases. Furthermore, the peak depth and velocity have been used, which may not occur at the same time leading to a conservative assessment of flood hazard. Appendix A.8 shows the flood hazard rating plan for the 1% AEP (Flood Zone 3a).

3.3.7. Developers must consider flood hazard, both within the site itself and in regard to any routes used to access the site. Safe access must be ensured for both pedestrians and vehicles, taking due regard of the vulnerability of the site users. If safe access and egress cannot be achieved in accordance with NPPF guidelines, the proposed development should not be permitted unless a Flood Evacuation Plan is submitted to and approved by the Local Planning Authority. This Plan must demonstrate that the danger to site users can be appropriately managed, without placing additional demands on emergency responders.

3.3.8. For further guidance on assessing safe access and egress for more vulnerable developments in Flood Zone 3a and highly vulnerable development in Flood Zone 2, refer to Section 6.

3.4. RESIDUAL RISK OF FLOODING

3.4.1. Whilst it is necessary to minimise the risk of flooding over the lifetime of the development in all instances, it is also important to recognise that flood risk may never be fully mitigated and there will often be a residual risk of flooding.

3.4.2. This residual risk is associated with a number of potential risk factors, including but not limited to the following:

- A flooding event that exceeds that for which flood risk management measures have been designed.
- The structural deterioration of flood defence structures (including de facto structures acting as a flood defence) over time.
- General uncertainties inherent in the prediction of flooding.

3.4.3. A small number of raised defences have been identified within the Borough, which are indicated on the fluvial flood maps in Appendix A.5, and which provide localised protection against fluvial flooding.

3.4.4. There is always a residual risk that these defences may fail, either by overtopping and/or a breach. The latter could result in rapid inundation of floodwater into areas behind the defence, posing a potential risk to residents, pedestrians and property that may be in the path of the floodwater.

3.4.5. Should a catastrophic structural failure of one of these raised defences occur during high water levels within the river, a wave of flood water could rapidly inundate the area immediately behind the breach. This may pose a risk to life to those immediately behind the defence at the time of failure.

3.4.6. It is essential that site specific FRAs for all potential future development situated within an area that has a residual risk of flooding as a result of defence failure, considers both the probability and consequence of defence failure in the vicinity of the site.

3.5. THE SEQUENTIAL TEST

3.5.1. In seeking to allocate a specific type of development or land use, planning authorities should apply the Sequential Test to demonstrate that there are no reasonably available, appropriate sites in areas with less risk of flooding. The Council should apply the Sequential Test when allocating sites in their LPU. The Sequential Test should also be applied to any windfall sites, since these sites will not have been included in the LPU. The test for windfall sites should be applied at the planning application stage.

3.5.2. The aim of the Sequential Test is to locate greater vulnerability development in the areas of lowest flood risk. Only where no suitable sites are available in Flood Zone 1 should a site in a higher risk flood zone be considered. Sequentially, development should be located in Flood Zone 2 before sites in Flood Zone 3a are considered. The functional floodplain Flood Zone 3b, should be protected; and only essential infrastructure development that passes the Exception Test and water compatible development should be permitted within it.

3.5.3. When locating sites in Flood Zones 2 or 3a, it is also necessary to take the vulnerability of the proposed development into account. The flood vulnerability reflects the land uses within the site and is a measure of the level of resilience to damages/danger from flooding. The Flood Risk and Coastal Change PPG categorises land uses into five vulnerability classes, ranging from essential infrastructure to water compatible development. These categories are then used to determine the appropriateness of a given land use within each flood zone. The flood risk vulnerability classification is shown in Table 5 below, which is taken from Table 2 of the PPG. The flood risk vulnerability and flood zone 'compatibility' is indicated in Table 6, which is taken from Table 3 of the PPG.

3.5.4. When allocating several developments of different vulnerabilities (assuming the vulnerability class is known, or suspected, at this stage), it is practical to allocate the most vulnerable developments first to ensure optimum placement in an area with the lowest flood risk. However, less vulnerable developments should continue to follow the sequential approach to steer as much development as possible to Flood Zone 1. Developments should not simply be allocated to zones with an 'acceptable' level of flood risk. For example, a 'more vulnerable' development should not be put in Flood Zone 2 if a suitable (i.e. taking other development considerations into account) Flood Zone 1 site is available.

Table 5: Flood Risk Vulnerability Classification

Classification	Land Uses
Essential Infrastructure	Essential transport infrastructure (including mass evacuation routes) which has to cross the area at risk. Essential utility infrastructure which has to be located in a flood risk area for operational reasons, including electricity generating power stations and grid and primary substations; and water treatment works that need to remain operational in times of flood. Wind turbines
Highly Vulnerable	Police and ambulance stations; fire stations and command centres; telecommunications installations required to be operational during flooding. Emergency dispersal points. Basement dwellings. Caravans, mobile homes and park homes intended for permanent residential use. Installations requiring hazardous substances consent. (Where there is a demonstrable need to locate such installations for bulk storage of materials with port or other similar facilities, or such installations with energy infrastructure or carbon capture and storage installations, that require coastal or water-side locations, or need to be located in other high flood risk areas, in these instances the facilities should be classified as 'Essential Infrastructure').
More Vulnerable	Hospitals. Residential institutions such as residential care homes, children's homes, social services homes, prisons and hostels. Buildings used for dwelling houses, student halls of residence, drinking establishments, nightclubs and hotels. Non-residential uses for health services, nurseries and educational establishments. Landfill and sites used for waste management facilities for hazardous waste. Sites used for holiday or short-let caravans and camping, subject to a specific warning and evacuation plan.
Less Vulnerable	Police, ambulance and fire stations which are not required to be operational during flooding. Buildings used for: shops; financial, professional and other services; restaurants, cafes and hot food takeaways; offices; general industry, storage and distribution; non-residential institutions not included in the 'more vulnerable' class; and assembly and leisure. Land and buildings used for agriculture and forestry. Waste treatment (except landfill and hazardous waste facilities). Minerals working and processing (except for sand and gravel working). Water treatment works which do not need to remain operational during times of flood. Sewage treatment works, if adequate measures to control pollution and manage sewage during flooding events are in place.

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

(Flood Risk and Coastal Change PPG)

3.5.5. Some developments may contain different elements of vulnerability and the highest vulnerability category should be used, unless the development is considered in its component parts.

Table 6: Flood Risk Vulnerability and Flood Zone 'Compatibility'

Flood Risk Vulnerability Classification	Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
Flood Zone 1	Suitable	Suitable	Suitable	Suitable	Suitable
Flood Zone 2	Suitable	Exception Test required	Suitable	Suitable	Suitable
Flood Zone 3a	Exception Test required **	Not suitable	Exception Test required	Suitable	Suitable
Flood Zone 3b	Exception Test required *	Not suitable	Not suitable	Not suitable	Suitable*

**** In Flood Zone 3a essential infrastructure should be designed and constructed to remain operational and safe in times of flood.**

*** In Flood Zone 3b (functional floodplain) essential infrastructure that has to be there and has passed the Exception Test, and water compatible uses, should be designed and constructed to:**

- Remain operational and safe for users in times of flood.
- Result in no net loss of floodplain storage.
- Not impede water flows and not increase flood risk elsewhere.

3.5.6. The Sequential Test should also take account of other sources of flooding such as surface runoff, groundwater or sewer flooding. The risk from other sources is not specified using zones but the risk may be perceived as significant, if persistent flooding has historically occurred or if modelling has become available that indicates a high likelihood of deep or fast flowing water.

3.6. THE EXCEPTION TEST

3.6.1. The Exception Test is appropriate for use where the Sequential Test is not able to deliver a sufficient number of suitable sites and where continuing development is necessary for wider sustainable development reasons. This takes into account the need to avoid social or economic blight and the need for certain services to be near their communities. For example, the flood risk due to siting a 'more vulnerable' health service in Flood Zone 2 may be outweighed by the needs of a local community to have a health centre within a practicable distance. It may be appropriate to use the Exception Test where restrictive national designations such as landscape, heritage and nature conservation designations (e.g. Sites of Special Scientific Interest), prevent the availability of unconstrained sites in lower risk areas.

3.6.2. The NPPF requires that for the Exception Test to be passed the following must be applied:

- It must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk, informed by a SFRA where one has been prepared.
- 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.

3.6.3. Both elements of the test will have to be passed for development to be allocated or permitted.

3.7. EFFECT ON FLOODING ELSEWHERE

3.7.1. A crucial aspect in planning new development is that the site itself should be safe and that the development does not increase flood risk elsewhere. In many cases, development may even provide an opportunity to reduce flood risk to surrounding areas.

INCREASE FLOODPLAIN STORAGE CAPACITY

3.7.2. One way of reducing flood risk at a borough-wide scale is to increase the capacity of the floodplain within the Borough, to enable a greater volume of water to be stored safely during a flood event. This will reduce the volume of flood water affecting developed areas of the Borough.

3.7.3. If defences are established to defend a site from fluvial flooding, or if land is raised so that buildings on the site are above flood water level, then the water will be displaced and may have to continue downstream and may well flood elsewhere. Therefore, measures such as floodplain compensation may be required that divert the flood water into an area where it can safely be stored. According to CIRIA (Construction Industry Research and Information Association) best practice guidance C624 '*Development and flood risk - guidance for the construction industry'* compensatory storage is required which should be volume-for-volume and level-for-level basis. This means that for each incremental rise in river level, the compensatory storage can accommodate at least as much volume of water as has been lost from the development site at that river level.

3.7.4. Wokingham Borough Council requires areas of floodplain compensation to provide a minimum increase in storage volume of 5% of the existing volume that will be lost as a result of the proposed development, on a level-for-level basis. Increasing the area available for storing flood water will help reduce flood risk to both the proposed development and neighbouring areas.

3.7.5. The re-development of sites located within the floodplain should be designed to reduce the overall built development footprint on the site by a minimum of 5%, to increase the area of the site that could be allowed to flood. This could be achieved by designing external areas of the site to flood, including car parks, public open space or roads that are not part of the safe access route for the site. This could also be achieved through flood sensitive design, for example through raising the development while enabling water to flow beneath it.

3.7.6. Compensatory storage may be provided on site by developing only part of the site and excavating the rest to compensate for the loss. This approach can only be taken if the area used to compensate for the loss is situated outside of the existing floodplain. Alternatively, it may be possible to identify a suitable area nearby, which is currently outside of the floodplain, but which can be connected to it and into which flood water may be diverted. The proposed changes to the floodplain resulting from this approach must be demonstrated using hydraulic modelling as part of the site-specific FRA for the site. The modelling must confirm that the proposed flood storage areas ensure the same level of protection is provided downstream.

SURFACE WATER RUNOFF MANAGEMENT

3.7.7. New development typically increases the amount of impermeable area so that a lower proportion of rainfall is able to infiltrate therefore increasing the rate and volume of surface runoff. This may drain overland to flood surrounding areas and if overland flows enter a watercourse it will increase river levels and may increase the risk of flooding downstream. Where surface runoff is drained into the sewer system there is a risk that the additional volume will exceed the capacity of the system.

3.7.8. To mitigate this, new developments are required to ensure that the site's peak runoff rates are not increased post development, and where possible are reduced. SuDS are recommended to manage the surface runoff and must take due account of groundwater and geological conditions (refer to Section 7). Further information on SuDS can be found in the Borough's SuDS Strategy[5] and Section 12 (Flood Risk Management) of the Wokingham Borough Sustainable Design and Construction SPD6.

3.7.9. The assessment of the effect of the development on flood risk is carried out by the developer in their FRA. In submitting their planning applications, developers must demonstrate the measures by which they will ensure that both the site and surrounding area are safe. Consideration of safe access and egress during a flood event must be demonstrated for the 1 in 100 year return period plus climate change event.

[5] Wokingham Borough Council (2016) Wokingham SuDS Strategy, available online at: www.wokingham.gov.uk/_resources/assets/attachment/full/0/399029.pdf

[6] Wokingham Borough Council (2010) Sustainable Design and Construction Supplementary Planning Document (SPD), available at: www.wokingham.gov.uk/EasySiteWeb/GatewayLink.aspx?alId=369287

RIVER NATURALISATION

3.7.10. Redevelopment of brownfield land near a heavily-modified river provides an opportunity to re-naturalise the watercourse to reduce flood risk. All development should consider how improvements to the water quality and amenity could be realised within the development layout.

3.7.11. For example, de-culverting a watercourse (daylighting) or moving buildings away from a river constrained within its channel and allowing it to be reconnected with its floodplain provides additional storage during flood events. Restoring channel meanders can help slow water down and provide floodplain between the meanders. These measures also bring further sustainability benefits of enhancing wildlife and making the river more accessible and appealing for people.

4

DATA COLLECTION AND ANALYSIS

4. DATA COLLECTION AND ANALYSIS

4.1. DATA AVAILABILITY

4.1.1. Available information on flooding has been sourced from Wokingham Borough Council (including previous SFRAs), the Environment Agency, Thames Water, local Parish and Town Councils and the Loddon Valley Residents Association. The information collated is summarised below:

- Historical flooding information;
- Flood modelling results - fluvial and indicative surface water maps;
- Flood defences;
- Hydrogeological information - bedrock geology, sand and gravel deposits, groundwater sources and source protection zones;
- LiDAR Topography maps;
- British Geological Society data - infiltration and aquifer maps;
- National Receptors Database - includes property points, environmental sites, historical sites etc., which might be affected by flooding.

4.1.2. This update to the Wokingham SFRA builds upon the previous versions. It includes the historical information collected for the previous SFRAs, along with additional incidents which have occurred since. The latest versions of flood risk information, such as the fluvial and surface water flood extents and modelling outputs, have been obtained from the Environment Agency. No additional fluvial or pluvial hydraulic modelling has been carried out by the Council as part of this SFRA. Extensive detailed modelling, produced by the Environment Agency, has been carried out for the rivers in Wokingham Borough.

4.2. NPPF TYPES OF FLOODING

4.2.1. This SFRA considers flooding from all sources recommended under the NPPF, typically summarised into the categories below:

FLUVIAL FLOODING

4.2.2. Fluvial flooding is caused by high flows in a river or other watercourse overtopping the banks.

4.2.3. The Thames Catchment Flood Management Plan[7], identifies that Wokingham has between 500 to 1,000 properties at risk from a 1%AEP fluvial flooding event.

4.2.4. The Environment Agency Flood Map for Planning (Rivers and Sea) illustrates the areas of the Borough that are at risk of flooding from fluvial sources. The Flood Map illustrates the risk of flooding associated with the 1% AEP and 0.1% AEP events across England and Wales, assuming an undefended situation. The flood extents are termed Flood Zone 3 and Flood Zone 2 respectively, where Flood Zone 3 covers both 3b and 3a. Areas with a risk of flooding less than 0.1% AEP are classified as Flood Zone 1.

[7]https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/293903/Thames_Catchment_Flood_Management_Plan.pdf

4.2.5. The adopted flood zones underpinning the SFRA are based upon the flood mapping within the area adjoining the River Thames. Whilst these provide a reliable depiction of flood risk for specific modelled conditions, all detailed modelling requires the making of core assumptions and the use of empirical estimations relating to (for example) rainfall distribution and catchment response.

4.2.6. Taking a conservative approach for planning purposes, it is understood that the Environment Agency (Thames Region) generally adopt a +/-150mm allowance for uncertainty within areas that have been modelled in some detail. The degree of uncertainty in areas reliant upon the Environment Agency's national generalised computer model will be somewhat higher (300mm). The implications for development control and developers are that development proposals, especially floor levels and safe access routes, should take account of these uncertainties.

4.2.7. The Environment Agency's national flood map was originally based on a fairly course modelling approach using JFlow software. However, these outlines are updated with more accurate results as detailed hydraulic modelling (using software such as ISIS / FMP, Tuflow or HecRas) is carried out on specific river systems.

4.2.8. Further updates to the flood zones are likely to occur as more detailed studies continue to be carried out on river catchments. Once the Environment Agency approves these studies the new flood outlines will be incorporated into their flood zone maps. SFRAs are intended to be living documents and should be regularly updated to take account of the latest flood zones.

SURFACE WATER FLOODING

4.2.9. Surface water flooding typically arises following heavy rainfall, resulting in either ponding of surface water within local low spots or flows across the ground surface where it is unable to infiltrate or drain to a receptor. It is therefore, an issue for built-up areas where there is a large proportion of land with impermeable surfaces, such as pavements, highways and buildings. Surface water flooding can also occur elsewhere if the ground is compacted and hard, if the rainfall is so intense that it exceeds the rate at which the ground can infiltrate, or if the ground is saturated.

4.2.10. The Environment Agency has published mapping of surface water flood risk based on computational hydraulic modelling. In December 2013 (updated December 2017) this map was updated and is now known as the '*Flood Risk Maps for Surface Water*' (FRMfSW). The mapping provides flooding extents from surface water for three storm events; the 3.3% AEP, the 1% AEP and the 0.1% AEP events. The mapping also provides information on the depth and velocity of flooding, as well as the hazard associated with the flood water.

4.2.11. The FRMfSW is considered to be a significant improvement on previous surface water flood maps and has been produced using improved modelling techniques & input data. It also benefits from incorporating locally produced mapping where available.

4.2.12. Although the FRMfSW is considered an improvement on previous mapping it still contains assumptions, the biggest of which relates to urban drainage capacity. Where available, local drainage rates have been incorporated into the model. In other areas a single drainage rate has been applied. Other benefits and limitations are included in the Environment Agency's '*What is the updated Flood Map for Surface Water?*'[8]

4.2.13. Flood maps for surface water are not intended to identify whether an individual property will flood, but should be considered in the preparation of any site-specific FRA and the design of proposed development. It is important to note that these maps should not be used as the primary factor guiding the site allocation process. The intention of the map is to act as a starting point to highlight areas where the potential for surface water flooding needs assessment and scrutiny. These maps should not be used in isolation in terms of assessing surface water flooding issues. Additional studies such as historical records should also be used as supporting evidence.

SEWER FLOODING

4.2.14. Sewer flooding arises when the drainage system is unable to cope with the volumes of rainfall during an event, causing pipes to back up and surcharge, which may lead to flood flows out of chambers. Flooding can also occur due to the ingress of groundwater into the sewer network, leading to overloading of the sewer system and subsequent flooding.

4.2.15. It is inevitable that localised flooding problems in urbanised areas will occur because of under capacity drainage and/or sewer systems. Adoptable surface water sewer systems are now typically designed to manage up to a 3.3% AEP flood event (in accordance with Government guidance) and highway drainage systems are generally designed to cater for 10% AEP events. Consequently, any event more severe than these is likely to exceed drainage system capacity, causing overland flow and often in an uncontrolled manner, which can then result in flooding.

4.2.16. Sewer flooding can also occur if the sewer system backs up and surcharges due to being unable to discharge from its outfall. For example, if a river/watercourse outfall becomes surcharged by increased water levels in the receptor. Blockages of sewers by debris is also a common cause of sewer flooding. This may result in flooding during minor rainfall events that the sewer should normally cope with. In the case of foul water sewers, this flood risk may not necessarily be due to a rainfall event but may also result in a public health issue.

4.2.17. Within Wokingham Borough, most sewers are public sewers, owned and operated by Thames Water. Whilst Thames Water maintains records of flooding from their sewers, due to data protection issues they only able to provide numbers of flooding incidents by postcode area, based on the first letter of the second part of the postcode. It should be noted that this covers a considerable geographical area. In addition, Thames Water may since have carried out works to their sewerage system to alleviate some of the historical problems. Records of flooding are not available for any privately owned sewers, unless they have been reported as flooding incidents to the Council.

[8] 'What is the updated Flood Map for Surface Water? (November 2013): https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/297432/LIT_8988_0bf634.pdf

GROUNDWATER FLOODING

4.2.18. Groundwater flooding is a particular risk for sites in low-lying areas over permeable geology. Groundwater flooding normally occurs in response to persistent rainfall causing the ground to become saturated, such that water levels rise above the level of the ground. With groundwater flooding locations often flat in gradient, it is difficult for the water to drain away. As re-infiltration cannot occur while the ground is saturated, groundwater flooding typically lasts for a significant length of time (in some cases several weeks or even months).

4.2.19. Information on groundwater flooding is typically sparse. The Environment Agency keeps a record of incidents reported to them. However, it should be noted that due to the ad-hoc nature of reporting by members of the public, a lack of historic data does not necessarily mean flooding did not occur. Furthermore, for the incidents reported, the cause of flooding is not always clear. For example, a report of cellar flooding might be assumed to be groundwater, but it is possible it may be leakage from a blocked or leaking drain or water supply pipe. A list of groundwater flooding incidents in the Borough was provided by the Environment Agency and is shown in Table 7 and Appendix A.5.

Table 7: Historic Groundwater Flooding

ID	Date	Location	Geology/ Aquafer	Incident	Notification	Comments
G1	06/12/2000	Earley RG6	-	Water in garden	Groundwater Sheet	-
G2	11/12/2000	Wokingham, RG40 4HD	-	Waterlogged garden	Groundwater Sheet	-
G3	15/01/2001	Woodley	River Terrace dep over London Clay Formation	Overflowing well/rising in garden	Phone Call	-
G4	22/03/2001	Sonning	London Clay, near g possible blockage, water not draining away properly	Local water levels?	-	-
G5	28/03/2001	Winneresh, RG41 5BA	Alluvium over London Clay	Subsidence in driveway	Groundwater Sheet	-
G6	01/06/2001	Reading, RG6 5UX	Gravels/London Clay	Seepage from verge since September 2000	Phone Call	Seepage likely as near edge of cap of Terrace Gravels
G7	24/10/2001	Wokingham, RG41 5BY	Gravels and Clay	Garden flooded and ponding	Phone Call-recommended to council	Pond filled with impermeable material, preventing proper drainage

ID	Date	Location	Geology/ Aquafer	Incident	Notification	Comments
G8	01/11/2001	Earley, Reading, RG6 5UX	Gravels/London Clay	Seepage from verge since September 2000 and standing water in garden	Phone Call & Groundwater Sheet	Need to investigate existing drainage and ways to enhance it.
G9	10/05/2002	Reading, RG10 8QB	Reading Beds / Chalk	Quite high ground here, well above Chalk WT, flooding probably related to perched WT in Reading Beds	-	-
G10	19/02/2004	Reading, RG7 1HE	London Clay (no drift)	Water has been in the garden for around a year. When it is pumped away it comes back in about an hour.	Advised on geology. Cannot be a natural groundwater flooding problem; more likely to be a pipe. Resident to chase with Thames Water.	-
G11	04/01/2005	Winnersh RG41 5EL.	Gravels on London Clay	Waterlogged surgery carpark - soakaway not helping.	Phone Call - may need drainage that bypasses building.	c. 18 inches

ID	Date	Location	Geology/ Aquafer	Incident	Notification	Comments
G12	26/04/2006	Ladd Garden Villages, RG10 9SB	Weald Clay	Drainage/ groundwater flooding	Water surge at Ladds Garden Village. No records of high groundwater level. Possibly, damaged sewer pipes. Thames Water directed customer to the Environment Agency without conducting tests. Furthermore, surface runoff could not produce reported volumes.	-
G13	17/05/2006	Reading, RG31 5HL	Gravel on top of London Clay	Retaining wall leaking, water collecting on patio, checked with Thames Water (not a leakage/ pipe problem, probably suggested it is a spring), problem since March 2006, only been in house for 18 months.	Not a groundwater problem – Environment Agency leaflet issued to resident.	-
G14	19/05/2006	RG6 5TR	River Terrace Gravels 6 underlain by London clay	Groundwater flooding enquiry	Water table under floorboards - Environment Agency leaflet issued to resident.	-
G15	30/06/2008	Arborfield Cross, RG2 9PQ	-	Flooding in cellar	-	-

ID	Date	Location	Geology/ Aquafer	Incident	Notification	Comments
G16	10/09/2008	Woodley, Reading, RG5 3QJ	Small gravel deposit over clay. A lake adjoins the gravel deposit so the levels in each are likely to be connected	Wet patch in the house. Concrete base in living room is getting very wet and bubbling up. Only started happening this year. The house is a 1950's built house.	Environment Agency leaflet issued to resident, along with contractors list. Suggested resident establishes whether any neighbours are experiencing the same issue. If not, it is recommended residents get a building surveyor to assess in case the house was not built properly.	-
G17	04/11/2009	Woodley, RG2 4BZ	Alluvium/London Clay	Water in ground/road following work to the gas main.	Called back: poorly drained because of London Clay, check drainage	-

4.2.20. In addition to historical incidents, which are typically sparse, the risk of groundwater flooding can be estimated by consideration of the underlying ground characteristics. Appendix A.9 shows the areas where the Borough is underlain by permeable geology (high infiltration potential), which corresponds with the areas most likely to be susceptible to groundwater flooding.

4.2.21. The north of the Borough is underlain by chalk bedrock, which is classified by the Environment Agency as a principal aquifer, indicating very permeable rock with high water-bearing potential. Adjacent to the chalk is Lambeth Group geology (clay, silt and sand) and in the south east of the Borough there are bands of Bagshot, Windlesham and Camberley (sand based rocks) and Claygate (sand, silt and clay). Whilst not as permeable as the chalk, these rocks do have reasonable water bearing potential and are classed as secondary aquifers.

4.2.22. Areas overlying either principal or secondary aquifers are at risk of groundwater flooding if the water table reaches the ground surface. The exception is where the aquifer is overlain by a layer of very low permeability geology, such as clay. According to the maps available, this only occurs in the far north of the Borough, where there is a superficial deposit of clay with flints. This would normally provide a protective layer which prevents groundwater escaping at the surface. However, buildings such as houses with basements may be at risk of groundwater flooding. Also, during development, there is a risk that building work could puncture the covering impermeable layer and thus provide a path for groundwater to reach the surface. This is particularly a potential issue if the aquifer is under groundwater pressure due to its being confined by the impermeable layer elsewhere.

4.2.23. Other types of superficial deposits can behave as local aquifers. Wokingham Borough contains quite extensive areas of river valley alluvium (sediment clay, silt, sand and gravel deposited by river) and plateau gravels which may pose a local risk of groundwater flooding. The River Thames gravels in particular are highly permeable and where they hydraulically connected with rivers, high water levels in the river can cause the water table in the gravels to rise, resulting in groundwater flooding in depressions remote from the river.

4.2.24. Equally, where flood defences have been constructed to mitigate the risk of fluvial flooding, a residual risk of groundwater flooding may remain. After a period of intense or prolonged rainfall, groundwater moves through the gravels, causing localised flooding behind the river defences. Fluvial defences could also impede the natural flow of groundwater into the river, thus resulting in a backing up of groundwater behind the defences, potentially exacerbating the risk of groundwater flooding.

4.2.25. Groundwater flooding is a likely occurrence in low-lying areas, where the normal groundwater level is already close to the surface, since these areas require the least amount of rainfall before the ground is saturated. Appendix A.6 shows the topography of the Borough, based on the latest LiDAR topography.

4.2.26. A further source of information is provided by the *Susceptibility to Groundwater Flooding Map*, which was created by the British Geological Survey (refer to Appendix A.9, figure 3905-SFRA-009(4)). The dataset, developed using a GIS rule-based methodology, defines areas that have the potential for flooding on the basis of the presence or absence of permeable or impermeable bedrock or superficial deposits.

FLOODING FROM RESERVOIRS

4.2.27. Artificial water bodies which hold water back behind impounding walls, may cause flooding if their holding capacity is exceeded or if a breach occurs in the walls. The consequences of flooding due to a breach (failure) can be particularly severe as it results in the immediate release of large volumes of high velocity water. However, because of this, reservoirs are subject to stringent safety standards.

4.2.28. The 1975 Reservoirs Act was introduced to ensure the safety of all impounded water bodies with a capacity over impounded 25,000m^3 of water. Under this Act all designated reservoirs must have an assigned supervising engineer from a specialised panel of engineers, who is responsible for the operation and maintenance of the reservoir. In addition, the reservoir must be inspected by a specialist panel engineer every 10 years, and they will specify a safe operating regime and any safety works which should be carried out.

4.2.29. Following the flooding in 2007, the Pitt Review recommended that the Government should produce inundation maps for all large raised reservoirs, indicating the effect downstream as the result of a dam breach.

4.2.30. The Flood and Water Management Act 2010 introduces some amendments to the Reservoir Act. The threshold for considering a reservoir has been reduced to 10,000m^3 and all such reservoirs must be registered with the Environment Agency. However, a more risk-based approach is followed for applying the full regulations which are only applied to those designated as 'high risk'.

4.2.31. In the event of an uncontrolled release of water from the reservoir, human life could be endangered. All reservoirs (high risk and others) must have a flood plan prepared by the undertaker (owner or operator of the reservoir) in consultation with an engineer (the supervising engineer for high risk reservoirs or an appointed engineer for other reservoirs), to be implemented if flooding occurs or is expected to occur.

4.2.32. Within Wokingham Borough, there are seven designated reservoirs (refer to Table 8). These are all over 25,000m^3 but there will be no additional reservoirs with the reduction in designation threshold to 10,000m^3.

Table 8: Reservoirs within the Borough of Wokingham

	Bearwood Lake	Black Swan Lake Dinton Pasture	Longmoor Lake	Maiden Erleigh Lake (no.1)	Queensmere	South-lake	Whiteknights Lake
Physical Status	In Operation	In Operation	In Operation	In Operation	In Operation	In Operation	In Operation
Situation	Near Wokingham	Near Wokingham	Near Wokingham	Near Reading	Near Wokingham	Near Reading	Near Reading
NGR	SU7730068600	SU7810072300	SU7850065100	SU7480071000	SU8150065500	SU7570072100	SU7380072300
Risk Category	B	Unknown	C	A	C	A	A
Undertaker Name	The Royal Merchant Navy School Foundation	Wokingham Borough Council	Wokingham Borough Council	Early Town Council	Moss	Wokingham Borough Council	The University of Reading
Category	Impounding	Impounding	Impounding	Impounding	Impounding	Impounding	Impounding
Year Built	1860	1979	1800	1885	1850	Unknown	1850
Surface Area (m2)	190,000	260,000	40,000		45,000	70,000	44,140
Dam Type	TE Earthfill	TE Earthfill	TE Earthfill	Gravity and Earthfill	TE Earthfill	Gravity and Earthfill	Gravity and Earthfill

Maximum Height of dam (m)	6	2	2	4	3	4.4	5
Capacity (m3)	314,000	200,000	70,000	25,000	45,000	100,000	70,000

4.2.33. Reservoir Flood Maps have been produced by the Environment Agency for large reservoirs over 25,000 cubic metres of water, which provide details of the anticipated flood depth and velocity of the flood water. Flood maps are not displayed for smaller reservoirs.

4.3. HISTORIC FLOODING

4.3.1. Wokingham Borough Council maintains a GIS database of all historic flood incidents since 2000. The database has been compiled using reports of flooding held by the Council, aerial mapping, officer site visits & investigations and requests from residents for support. Plans showing historical flooding are provided in Appendix A.5 and further information on the flood events that have impacted the Borough in recent years is outlined below.

4.3.2. Wokingham Borough Council has undertaken a number of Flood Investigation Reports, and these can be found at:

- *http://www.wokingham.gov.uk/community-and-safety/emergencies/drainage-and-flooding/*

FLOODING IN 1993

4.3.3. As part of the previous SFRA, detailed discussions were held with Wokingham Borough Council to identify areas known to have experienced historical flooding. This resulted in the creation of a GIS layer showing spot locations of reported flooding problems in 1993 due to foul water drainage, highway drainage, land drainage (countryside runoff), surface water drainage (urban runoff) and locations of restricted toilet use.

AUTUMN 2000 FLOODING

4.3.4. Across the country, October and November 2000 were the wettest autumn since records began approximately 270 years ago. The heavy rainfall caused prolonged, extensive and in some places, repeated flooding, with flood levels in many places being the highest on record.

Within Wokingham Borough, approximately half of the flooding was associated with main rivers (such as the Loddon, Thames, Emm Brook and Twyford Brook) overtopping their banks or failure of flood defences (see Section 4.4 for further information on flood defences in the Borough). Slightly less than half of reported incidents resulted from problems with highway drainage. Smaller percentages related to problems with land drainage and yet a smaller portion could be ascribed to public sewers. This information was summarised by parish area in the Wokingham Flood Mitigation Study (Parkman, 2001) and is reproduced in

4.3.5. Table 9 below. GIS layers and more detailed geographical information are not available, so the information cannot be mapped as part of the SFRA.

Table 9: Incidents of Flooding in 2000-01 by Parish

Source Parish	Main River	Land	Highway	Thames Water Utilities
Arborfield	9	10	3	0
Barkham	2	2	4	0
Charvil	56	0	0	0
Early	18	4	28	1
Finchampstead	6	18	29	1
Hurst	16	2	2	0
Remenham	17	0	0	0
Ruscombe	1	0	18	0
Shinfield	16	13	15	0
Sonning	0	1	2	0
Swallowfield	17	4	7	0
Twyford	8	3	11	0
Source Parish	Main River	Land	Highway	Thames Water Utilities
Wargrave	27	3	13	0
Winnersh	50	3	19	0
Wokingham	35	3	53	13
Wokingham W/O	0	0	3	3
Woodley	16	2	21	3
	294	68	228	21
			TOTAL	611

4.3.6. The '*Wokingham District Council Report of the Select Committee on Flooding*' (2001) states that within Wokingham Borough 605 locations were recorded as affected by flooding (with over 8,000 sandbags issued). Several of these were roads such as the A329 and A327, along with many other minor roads in Swallowfield and Arborfield, which had to be closed for traffic, in many cases for about two days, whilst the A321 was threatened.

JANUARY 2003 FLOODING

4.3.7. Although no specific records are available for 2003, information provided along with the 2007 flood event report noted that within the Borough, recurring flooding has been observed for events in October 2000, January 2003 and July 2007. This includes the following:

- Flooding along the River Loddon of residential property, and of the Loddon Bridge roundabout, Showcase Cinema complex and Winnersh Triangle Trading Estate, which has led to disruption to transport and industry in the area;
- Flooding along the Emm Brook at Sylvester Close, Emm Brook School, some properties within the residential area downstream of Barkham Road and on Finchampstead Road adjacent to the Tesco store. Additionally, in 2007 much of the Molly Millar's Lane trading estate was flooded, as were some properties in the Landen Court development downstream of the Tesco store.

JULY 2007 FLOODING

4.3.8. In July 2007 flooding was experienced across most of the country. A key aspect of this event was that much of the flooding was due to surface runoff, which served to highlight the importance of considering other sources of flooding (compared to the traditional focus on fluvial flooding).

4.3.9. As a result of the unprecedented rainfall which fell between 17th and 29th July 2007 (which at one point almost a month's average rainfall fell within just a few hours), approximately 300 properties within the Borough suffered flooding. Of those, 140 properties were flooded internally (house or garage).

4.3.10. Based on the calls made to the council reporting internal flooding, a GIS layer was produced showing those incidents that occurred outside the flood zones (115). This layer has been incorporated into the Borough's historic flood records layer shown on the historical flood mapping in Appendix A.5. The 2007 flood event is also referred to in the following paragraph 2.21 of the adopted Wokingham Borough Core Strategy (2010):

> *The Council also needs to consider the avoidance of areas at risk of flooding, especially after the floods in 1999/2000 and July 2007, which caused disruption around the borough. This included the problems of accessing the facilities and services in Reading after the River Loddon burst its banks preventing access along most of the key highway routes.*

4.3.11. The 2007 flood event resulted in access problems for emergency services between Winnersh and Reading (i.e. Royal Berkshire Hospital). In addition, the existing highway infrastructure at the Winnersh Showcase Roundabout and parts of Lower Earley Way has a history of flooding.

WINTER 2013/14 EVENT

4.3.12. The flood event of winter 2013/14 covers the period from mid-December 2013 to early March 2014, during which time areas in Wokingham Borough were affected by flooding as a result of prolonged, persistent and heavy rainfall.

4.3.13. Between the 13th December and Christmas Day, the total rainfall across Wokingham was up to 100mm in places, resulting in the River Loddon and the River Blackwater flooding out of their banks. This was followed by a second period of heavy rainfall around New Year and the first week of 2014, with rainfall totals between the 30th December and the 8th January averaging 90mm. Heavy and sustained rainfall at the end of January and during the first week of February caused levels to rise once again. The continual rainfall throughout January and February resulted in water levels on the Lower Thames reaching their highest level for more than 65 years.

4.3.14. The worst affected areas were those located close to the major rivers in the borough; the River Loddon, the River Thames and the River Blackwater. The river and groundwater levels in the catchments were high throughout the period. The villages of Arborfield, Swallowfield, Shinfield, Charvil, Hurst and Wargrave were most significantly impacted by the flood event, with a total of 40 properties experiencing internal flooding across the six villages and a further 48 properties experiencing external flooding.

WINTER 2015/16 EVENT

4.3.15. The winter of 2015/16 brought significant wet weather for many parts of the UK, resulting in severe flooding in December and the first week of January. Significant rainfall experienced in Wokingham and the surrounding area during this period resulted in the River Loddon and the Emm Brook bursting their banks. This in turn resulted in many roads flooding, including key links between Wokingham and Woodley.

SEPTEMBER 2016 EVENT

4.3.16. September 2016 brought significant wet weather for many parts of the UK, with intense bursts of rainfall reported across the Thames Valley. The significant rainfall experienced in Wokingham and the surrounding resulted in high volumes of surface water runoff being generated in a short period of time. The intensity of the rain and hail resulted in large amounts of vegetation being dislodged from trees and hedges, which gave rise to blockages in the roadside gullies and highways drains.

JULY 2017 EVENT

4.3.17. The July 2017 resulted in reported flooding occurring at over fifty properties across the Borough. The flooding was caused by a short duration high intensity storm that overwhelmed the available surface water sewer and drainage capacity in localised areas. Many of the properties affected were within areas identified as being at risk from the FRMfSW, whilst some were not.

PARISH FLOODING RECORDS

4.3.18. Information has been sought from Parish Councils to include within this SFRA update. It is understood that much of the flood data was collected retrospectively and there are significant gaps in the records. Furthermore, much of the data is classified as being confidential and it is therefore, not included in this SFRA.

ENVIRONMENT AGENCY HISTORICAL FLOODING RECORDS

4.3.19. The Environment Agency maintains a national GIS map of historic flooding outlines. The incidents recorded by the Environment Agency are shown Appendix A.5. Generally, the records relate to fluvial flooding, but it should be noted that identifying the source of flooding in practice is not clear cut. Many flood incidents may have been caused by a number of factors.

EFFECTS OF CLIMATE CHANGE

4.3.20. A considerable amount of research is being carried out worldwide in an endeavour to quantify the impacts that climate change is likely to have on flooding in future years. Climate change is perceived to represent an increasing risk to low lying areas of England and it is anticipated that the frequency and severity of flooding will change considerably.

4.3.21. The Environment Agency *Flood Risk Assessments: Climate Change Allowances*[9] states that within the Thames River Basin District peak river flow is expected to increase between 10% and 25% within the next 25 years, rising to between 15% and 35% within the next 65 years. Within the next 100 years, peak river flow is expected to increase between 25% and 70% within the Thames River Basin District.

4.3.22. The Environment Agency guidance also provides the anticipated changes in extreme rainfall intensity across the country. Over the next 100 years, the increase in extreme rainfall intensity is expected to be between 20% and 40%.

4.3.23. Whilst present day flood extents should be used to establish flood zones at a development site, the NPPF requires that developers should also consider the possible change in flood risk over the lifetime of the development resulting from climate change. The likely increase in flow and rainfall intensity over the lifetime of the development should be assessed proportionally to the guidance provided by the Environment Agency and the requirements detailed in Section 5 and 6. The Environment Agency guidance specifies the exact climate change allowance that should be applied for each type of development, depending on the Flood Zone in which it is located and flood source to which it is exposed.

4.3.24. To account for the absence of this information, the SFRA utilises the current 0.1% AEP flood outlines as a proxy for the 1% AEP plus climate change event. Experience has shown that in other areas (i.e. in which detailed modelling has been undertaken and is in the process of being accepted by the Environment Agency), the anticipated extent of the 1% AEP flood affected area for the period from 2025 to 2115 can be approximated by the current 0.1% AEP flood outline (i.e. Zone 2 Medium Probability). Within the Borough, this indicates a relatively small increase in the number of properties at risk of flooding. Therefore, in the absence of Flood Zone 3a climate change extents, the climate change flood maps in this SFRA rely upon the Flood Zone 2 flood extent (refer Appendix A.5). When the Flood Zone 3a climate change flood extent becomes available the maps should be updated.

4.3.25. It should also be noted that those properties (and areas) that are currently at risk of flooding may be susceptible to more frequent, more severe flooding in future years. It is therefore essential that the development control process (influencing the design of future development within the Borough) carefully mitigates against the potential impact that climate change may have upon the risk of flooding to property.

[9] Environment Agency (March 2016) Flood Risk Assessments: Climate Change Allowances, available at www.gov.co.uk

FLOOD RISK TO PROPERTIES AND VULNERABLE SITES

4.3.26. Overview maps of the present-day flood zones and surface water flood extents are provided in Appendix A.5. These maps show that many of the key population centres within the Borough are situated adjacent to river corridors, resulting in a number of properties being at risk of fluvial flooding and in areas of significant surface water flood risk. However, the percentage of properties shown to be at risk makes up a small proportion of the total number of properties within the Borough, as the majority of properties are in Flood Zone 1.

4.3.27. In addition to the risk of fluvial and surface water flooding, properties are also potentially at risk of localised flooding from groundwater and/or sewer overload. Maps in Appendix A.5 give some indication of likely properties at risk (although sewer flooding in particular is unpredictable in nature where it arises from ad-hoc incidents such as blockages and thus, any property may potentially be at risk).

4.3.28. Within Wokingham Borough, relatively few vulnerable sites are located within flood risk areas. Of these most are within Flood Zone 2, which is acceptable for all the vulnerability classifications in these instances (more vulnerable, less vulnerable and essential infrastructure). However, emergency plans should be put in place for the event of an extreme flood.

4.4. FLOOD PROTECTION MEASURES

FLOOD DEFENCES

4.4.1. The Flood Map for Planning also indicates the presence of flood defences, which are structures that affect flow in times of flooding. Flood defences generally fall into one of two categories; 'formal' or 'de-facto'/'informal':

- A 'formal' defence is a structure which has been specifically built to control floodwater. It is maintained by its owner (this is not necessarily the Environment Agency), so that it remains in the necessary condition to function.
- A 'de-facto' or 'informal' defence includes road and rail embankments and other linear infrastructure (buildings and boundary walls), which may act as water retaining structures or create enclosures to form flood storage areas in addition to their primary function. Other structures are identified on the Environment Agency database, but these have not necessarily been built to control floodwater and are not maintained for this purpose.

Formal raised flood defences within the Borough have been identified in consultation with the Environment Agency. The defences identified are highlighted in the Flood Zone maps in Appendix A.5. The main formal raised defences within the Borough are detailed in

4.4.2. Table 10. No de-facto flood defences have been specifically identified in the Borough as part of the SFRA process.

Table 10: Flood Defences

Ref	Asset Type	Asset Description	Asset Location	Length	Height

D1	Raised defence (man-made)	Flood bund. 0.5 to 1.3m high flood bund with vegetation growing on it.	Near Thames Water Sewage works, north of Henley-on Thames, South Oxfordshire District Council (outside of Borough but only just upstream).	358.9	0.5
D2	Culverted Channel	Culvert under road CU. 750 mm diameter culvert runs under college access road and A4155.	Grounds of Fawley Court, north of Henley-on-Thames, South Oxfordshire District Council (outside of Borough but only just upstream). Note that D1 and D2 are in the same location.	191.4	0
D3	Flood Defence Structure	Access road embankment – Road built on a raised earth embankment. Only access to lock / weir complex during a flood event.	Hambleden lock access Road.	562.4	1

4.4.3. It is essential to recognise that flood defences do not fully eliminate the risk of flooding to properties within the Borough. In many areas the standard of protection provided by the defences is less than 1% AEP. Flooding may also occur due to breach. In addition, it should be recognised that there is a risk to properties situated behind the defences as a result of groundwater flooding and/or surface water flooding, exacerbated by high river levels. Flood defences do not fully remove the risk of flooding and a residual risk will always remain.

FLOOD STORAGE

4.4.4. A flood storage area lies along the Foudry Brook immediately downstream of the Borough. As it is downstream, its impact on Wokingham is minimal.

4.4.5. There are several informal lakes and meadows within the Borough, such as those in the Dinton Pastures Country Park along the Lower Loddon and several along the River Blackwater just south of Finchampstead (Moor Green Lakes). These all serve to attenuate flood water and reduce flooding downstream.

There are also several small flood storage areas/balancing ponds which deal with local runoff. These are listed in

4.4.6. Table 11 and shown in Appendix A.4.

Table 11: Balancing Ponds

Ref	Street	Parish
BP1	Easthampstead Road	Wokingham Without
BP2	Foxborough	Swallowfield
BP3	Curlys Way	Swallowfield
BP4	Skylark Way	Shinfield

BP5	The Brackens	Wokingham Without
BP6	The Naylors	Swallowfield
BP7	Foxborough	Swallowfield
BP8	Twycross Road	Wokingham
BP9	Woosehill	Wokingham
BP10	Woosehill Lane	Wokingham
BP12	Wildcroft Drive	Wokingham
BP13	Deacon Close	Wokingham
BP14	Gazelle Close	Winnersh
BP15	Wimbushes	Finchampstead
BP16	Plough Lane	Wokingham
BP17	Mereoak Lane	Shinfield
BP18	Basingstoke Road	Shinfield
BP19	Fullbrook Avenue	Shinfield
BP20	Fullbrook Avenue	Shinfield
BP21	Pither Close	Shinfield
BP22	Pither Close	Shinfield

STRUCTURES

4.4.7. The Environment Agency records also include structures along the river as shown in Table 12. In some cases, these may have some effect on flood risk. For example, sediment may build up behind weirs thus reducing the capacity of the channel or bridges may act as a flow constriction causing water to back up. This effect is normally predicted by any modelling but may be worsened in a specific event if debris such as branches obstructs them.

Table 12: Structures

Ref	Asset Type and Location	Asset Comments	Height	Width
S1	Thames Weirs - Shiplake Weir A	3x 1.8m wide x1m high radial gates 6x 3m wide x 2.3m high radial gates 1x 1.2m wide x1m high gated fish pass further 2 radial gates 1.8m wide x 1m high Overall weir width 36m. Concrete walkway & concrete channel sides. Weir is manually operated.	1.2	36
S2	Thames Weirs - Shiplake Weir B	3 step concrete fcw concrete & steel walkway steel handrails concrete channel sides overall width 25m	1.2	25
S3	Flood Culvert - Mill Lane, Shiplake	brick arch culvert under road	1	1.2
S4	Flood Culvert - Mill Lane, Shiplake	brick arch culvert under roadway	1	1.2
S5	Thames Weirs - Marsh Weir A	8X4m wide electrically operated Buck Weir and Fish Pass.	3	36
S6	Thames Weirs - Marsh Weir B....Between Island & L/B	Adjustable weir left bank, with Gauge Weir to right bank.	1.2	8
S7	Weirs - - Marsh Weir (Mill Sluice 1)	Mill Sluice under flats upstream of culvert is a weir with 1.3m drop	1.8	
S8	Thames Weirs - Marsh Weir (Mill Sluice 2) Marsh Mill Flats	Mill Sluice. Masonry Culvert with u/s weir having a drop of 1.3m Culvert runs under a building/flats	1.9	2
S9	Bridges - Footbridge North Of Mill Pool Cottage	Wooden Footbridge with 2 central supports in Channel bed. Handrails u/s and d/s sides	3.2	20
S10	Thames Towpath Bridges - Bridge 102 At Shiplake Hole		0	
S11	Flood Culvert - Mill Lane Shiplake	Twin Brick arch culvert under road to allow flow of flood waters	1	1.2
S12	Flood Culvert - Mill Lane, Shiplake	Brick arch culvert under road-to allow flood flows	1	1.2
S13	Bridges - East Of Brookend	Access bridge with masonry parapets	1	4.5
S14	Thames Weirs Weir C - Hambleden Weir C.Lr2.	Weir with 2x 2m wide steel lifting radial gates	3	4.8
S15	Thames Weirs Weir B. - Hambleden Weir B	2 stage fixed crest weir with steel and concrete walkway over, supported by 20 sets of steel supports.	2	95
S16	Thames Weirs Weir A - Hambleden Weir A	Weir with 4x steel tipgates and steel walkway over. plus 1x fish pass	5	16
S17	Thames Weirs Weir D - Hambleden Weir D	4 stage fixed crest weir with steel walkway.	2.2	42
S18	Thames Weirs Weir E - Hambleden Weir E	2x 3m wide lifting steel radial gates.	2.5	7
S19	Thames Weirs Weir F - Hambleden Weir F	Weir with concrete sill and spillway. Footway over, supported by steel A frames.	1.6	50
S20	Thames Weirs Weir G - Hambleden Weir G	3x 2m wide steel radial gates, Electric	0	9
S21	Thames Weirs - Hambleden Weir (Mill Stream)	Mill Sluice - manually operated steel/wooden sluice gate, with operation walkway over, upstream end of culverted channel.	1.5	1
S22	Bridges - Footbridge South Of Lake Cottage Willow Lane	Brick Bridge with angled side abutment piers upstream and downstream both banks	1.2	4
S23	Thames Weirs - The Mill Theatre, Sonning Weir (Mill Stream)	Mill Sluice/ culvert, sythonic weir, electric turbine in pipe. Trash screen upstream.	2	2
S24	Thames Weirs - Sonning Weir C	2x 2.5m wide radial lifting gates manually operated operating gantry upstream over weir	2	6.5
S25	Thames Weirs - Sonning Weir A	4x 3m wide radial gates remotely operated	2	16
S26	Thames Weirs - Sonning Weir D	65m long fixed crest weir includes 1m wide fish pass with walkway over entire length	1.8	65
S27	Thames Weirs - Sonning Weir B	2x manually operated 3.2m wide lifting gates	2.5	10
S28	Thames Locks - Sonning Lock	Concrete pound lock with hydraulically operated steel gates upstream & downstream	1	6
S29	Thames Towpath Bridges - Bridge 100B Sonning Hill	Timber footbridge	0.5	2

4.4.8. The main consideration for development regarding the structures identified in Table 12, is that where a structure is accessed via a proposed site, the access will need to be maintained. In many cases access is required for non-flood risk purposes, but in some cases access is required to carry out maintenance such as dredging channels, where silt has built up behind weirs. The information is included in this SFRA so that it may be taken into account for future planning applications, where relevant.

4.4.9. In the case of proposed schemes such as flood storage or where land management restrictions exist, since this land has been specifically designated to aid flood management, it is recommended that it should be considered as a spatial constraint to development proposals. Structures such as weirs may also pose a constraint to future development since access will need to be maintained.

4.5. COMMUNITY RESILIENCE (EMERGENCY PLANNING)

FLOOD WARNING

4.5.1. The Environment Agency operates a flood warning service in England and Wales for areas at risk of flooding from rivers or the sea. Rainfall and river levels are monitored 24 hours a day at a number of Flood Warning telemetry stations and this information is used to forecast the probability of flooding. Flood warnings are issued using a set of four codes, which indicate the anticipated level of risk. It should be noted that the following codes are not always used in sequence:

- **Flood Alert** is issued when flooding is possible ("be prepared");
- **Flood Warning** is issued if flooding is expected ("immediate action required");
- **Severe Flood Warning** if there is danger to life; and,
- **Warning no longer in force** is issued once no further flooding is currently expected.

4.5.2. Flood warnings are issued in the news media and on the Environment Agency website. In addition, personalised warnings (sent by automated phone, fax or email messages) are available for those in specific Flood Warning Areas. This is a free service that aims to provide people with two hours advance lead time to prepare for flooding. However, in certain cases this may not always be possible, for example in instances of flash flooding. Flood Warning areas cover communities at risk of flooding and are mapped using Flood Zone 2, where there are settlements. The following Flood Warning Areas exist within, or partly within, Wokingham Borough:

- River Thames for Henley, Remenham and Medmenham
- River Thames for Shiplake, Lower Shiplake and Wargrave
- River Thames in the Playhatch, Sonning and Sonning Eye area
- River Thames at Reading and Caversham
- Properties closest to the River Thames from Scours Lane, Reading to Caversham Lakes
- River Loddon at Twyford, Charvil and Wargrave
- River Loddon at Lower Earley and Sindlesham
- River Loddon at Winnersh and Woodley
- River Loddon at Arborfield and Shinfield
- River Loddon and River Blackwater at Swallowfield
- River Whitewater at North Warnborough, Hook and Riseley
- River Blackwater at Eversley and Bramshill
- River Loddon at Sherfield-on-Loddon
- Emm Brook at Wokingham
- Foudry Brook from Stratfield Mortimer to Green Park

- River Kennett from Theale down to Reading

4.5.3. The Environment Agency encourages those within Flood Warning Areas to register for the Floodline Warnings service. Further information can be found at https://www.gov.uk/sign-up-for-flood-warnings or by calling Floodline on 0345 988 1188.

4.6. CRITICAL DRAINAGE AREAS

4.6.1. No Critical Drainage Areas have been defined by the Environment Agency within Wokingham Borough.

4.6.2. As part of this SFRA process, areas 10m landward of the current Flood Zone 3B and including Flood Zone 3B, have been identified as areas needing to be safeguarded for future flood protection uses, as identified in Appendix A.11.

4.7. FLOODING HOTSPOTS

4.7.1. The instances of recorded flooding within Wokingham Borough Council have been analysed to create a heat map, identifying where the most recorded incidents of flooding have occurred. This mapping is presented in Appendix A.12 and indicates that the main hotspots of flooding occur around the Parishes of Earley, Winnersh and the settlement of Matthew's Green. These areas represent some of the most populated portions of the Borough and therefore, there is a greater likelihood of flooding reports being generated.

4.7.2. Wokingham Borough Council is reviewing the flood risks in each of these areas and is developing plans to tackle flooding.

4.8. FLOOD MANAGEMENT APPROACH

4.8.1. The Thames Catchment Flood Management Plan (CFMP) identifies that the Loddon is an area of open undeveloped floodplain with villages and market towns. Winter flooding of the undeveloped floodplain is a regular occurrence and this floodplain provides a large area to store water, which reduces the risk to more than 100 communities at risk. Under the CFMP the area is covered by Policy Option 6, which is defined as:

- Areas of low to moderate flood risk where the Environment Agency will take action with others to store water or manage runoff in locations that provide overall flood risk reduction or environmental benefits.
- Retain the remaining floodplain for uses that are compatible with flood risk management and put in place polices that lead to long-term adaptation of urban environments in flood risk areas.

4.8.2. To safeguard land for current and future flood management, floodplain storage and conveyance must not be adversely impacted. To safeguard this land any activities taking place within the 1 in 1,000 year return period plus climate change extents, determined by detailed analysis at the site level, should be assessed and be able to demonstrate an overall increase in floodplain volume and conveyance potential.

4.8.3. To avoid increasing the risk of flooding within the Wokingham Borough all new developments must deliver sustainable drainage in accordance with the Wokingham SuDS Guidance. This measure will minimise the risk of development increasing flood risk to others. Furthermore, any works should consider the retrofit of SuDS where practicable, to help reduce the overall Borough flood risk.

5

OVERVIEW OF FLOOD RISK BY CHARACTER AREA

5. OVERVIEW OF FLOOD RISK BY CHARACTER AREA

5.1. WOKINGHAM BOROUGH CHARACTER AREA MAPS

5.1.1. The Borough has been delineated into character areas for the assessment of flood risk, taking due consideration of Parish boundaries, socioeconomic and future planning characteristics. Flood risk maps for each character area are shown in Appendix A.7. There is some overlap of character areas, in which flooding is discussed, based on the character area in which the town predominantly falls to avoid duplication (except for some of the larger towns such as Wokingham). Where character areas extend beyond the Borough boundary, the area outside is not discussed. Some of the historical flooding discussed occurred many years ago (e.g. the 1947 flood event) when some of the urban areas may not have existed. However, flooding is discussed as if these areas did exist, which is a precautionary approach.

5.2. CHARACTER AREA 1: PARISHES OF REMENHAM AND WARGRAVE

5.2.1. Character Area 1 covers the parishes of Remenham and Wargrave, located in the north of the Borough. It is largely rural in nature, and the River Thames runs along the western and northern borders of the character area. Most of the Character Area is in Flood Zone 1. There are relatively few ordinary watercourses in the Character Area, although one of note is a culverted stream that passes through the centre of Wargrave.

5.2.2. The Character Area has experienced fluvial flooding along the River Thames corridor in March 1947, November 1974, February 1990, September 1992, October 1993, December 2000, January 2003, July 2007, February 2009 and the winter 2013/14. Most of these are about the width of the functional floodplain (Flood Zone 3b), although the 1947 flood event was particularly severe and has been used to update Flood Zone 2. Flooding by Aston and Lower Culham Farm reached the borders of the villages and may have affected some of the properties nearest the river. At Remenham and Wargrave several properties lie well within the flooded areas.

5.2.3. The Character Area's largely rural nature means there is currently relatively low susceptibility to surface water flooding, with most of the flooding along the main roads through each of the settlements. Two highways in the area experienced surface water flooding in January 2015, because of a combination of high groundwater levels and surface water runoff. The historical incidents recorded in the Character Area are predominantly along the key surface water flood risk routes through the parish. Although not reflected in the modelling, the very high permeability of chalk areas also contributes to a low risk of surface water flooding. Therefore, the runoff characteristics of this Character Area might be expected to be particularly sensitive to increases in impermeable area following development.

5.2.4. The Character Area is underlain by Chalk bedrock which is generally a particularly permeable type of geology, able to release quite large volumes of water if groundwater levels reach the surface. There are also several superficial deposits of permeable alluvium and gravels. Conversely, at Remenham Hill there is a capping layer of low permeability clay-with-flints, which is likely to act as a barrier preventing groundwater rising to the surface in this area. However, there may still be a risk for basements. At Knowl Hill there is also low permeability London Clay bedrock geology, so this area is unlikely to be susceptible to groundwater except in the localised areas with more permeable superficial deposits.

5.3. CHARACTER AREA 2: PARISHES OF SONNING, CHARVIL, TWYFORD AND RUSCOMBE

5.3.1. Character Area 2 is located towards the north of the Borough and contains the parishes of Sonning, Charvil, Twyford and Ruscombe. About a third of the Character Area is settlement but the remainder remains rural. The River Thames passes along the western boundary and the River Loddon through the centre of the Character Area, joining the Thames in the north of the Character Area. The northern streams of the Twyford Brook catchment flow through the east of the Character Area. Several ordinary watercourses flow through the rural parts of the Character Area and there are several lakes along the River Loddon (and also some along the River Thames but these are outside the Borough). The main settlements in the Character Area are largely in Flood Zone 1 and of the remaining Character Area, while about half lies within Flood Zones 2, 3a and 3b.

5.3.2. The Character Area has experienced fluvial flooding in March 1947, November 1974, August 1977 (Thames only), December 1981 (Loddon and Twyford Brook), February 1990 (Loddon), February 1991 (Loddon), September 1992 (Thames), December 2000 (Loddon and Thames), January 2003 (Loddon and Thames), July 2007 and Winter 2013/14. In many cases the historical flood events reached and even exceeded Flood Zone 3a.

5.3.3. The FRMfSW indicates all of the main settlements in the Character Area are at risk of surface water flooding, but most particularly Charvil and Twyford, which have a greater amount of deeper flooding. This is likely to be due to their low-lying nature so that they receive flows from the surrounding areas. The historical surface water incidents are fairly scattered with no clear areas at worse risk, except possibly the FRMfSW main route through Twyford, which has two incidents from 1993 along (or very close to) its path. Both these incidents are foul water sewer flooding, indicating sewer capacity is likely to have been exceeded.

5.3.4. The Character Area is one of the most permeable of the Borough, with highly permeable chalk geology to the north and reasonably permeable Lambeth Group (clay, silt and sands) bedrock to the south. The Character Area is also almost entirely covered by permeable alluvium and gravel. These geology types suggest that groundwater flooding may be a risk, and there has been an incident recorded in Sonning.

5.4. CHARACTER AREA 3: TOWNS OF EARLEY AND WOODLEY

5.4.1. Character Area 3 is located in the west of the Borough and contains the towns of Earley and Woodley, which are both almost entirely urbanised. The River Loddon runs along its eastern boundary and the River Thames along part of its northern boundary. However, the Character Area is predominantly in Flood Zone 1. The key ordinary watercourses flow beside the A3290, beside Lower Earley Way and through the centre of Earley including through Maiden Erleigh Lake.

5.4.2. The Character Area has experienced fluvial flooding in March 1947, September 1968 (minor flooding on Loddon), November 1974, August 1977 (Thames only), December 1981 (Loddon), February 1990 (Loddon), February 1991 (Loddon), December 2000 (Thames), January 2003, July 2007 and February 2009 (minor flooding on Loddon). The historical extents generally reached at least Flood Zone 3a and more than once, Flood Zone 3b.

5.4.3. Both the FRMfSW modelling and historical surface water flooding indicates the Character Area is very susceptible to surface water flooding. In particular, along Coleman's Moor Road there were a number of incidents in 1993, which included foul water sewer flooding. In the vicinity of the ordinary watercourse by Egremont Drive and Gipsy Lane, a number of incidents in 2007 suggest some property was flooded by surface water runoff on its way to the stream. A number of roads along Kilnsea Drive were flooded in 2007 and in another instance by surface runoff. The surface water modelling also indicates these areas would be at high risk of surface water flooding. Another key area highlighted by the modelling is to the east of the allotment gardens and Bulmershe Secondary School in Woodley, although as yet no incidents have been recorded there.

5.4.4. Apart from a small area of Chalk and Lambeth Group bedrock in north Earley, most of the Character Area is underlain by London Clay bedrock, which is low permeability. However, there are extensive superficial deposits of sand and gravel, which act as local aquifers and pose a risk of groundwater flooding. The risk is confirmed by two Environment Agency groundwater flooding incidents, which are known to have occurred in the Character Area.

5.5. CHARACTER AREA 4: PARISH OF HURST

5.5.1. Character Area 4 is located in the east of the Borough and corresponds to the parish of Hurst. It is predominantly rural in nature and contains the Twyford Brook's southern network of stream tributaries, with the River Loddon running along the western boundary. There are several lakes along the River Loddon, including the Dinton Pastures Country Park. Most of the Character Area is in Flood Zone 1, although a substantial part is in Flood Zone 2. In the west of the Character Area most of the watercourses are classified as main river, whereas in the east there are several ordinary watercourses.

5.5.2. The Character Area has experienced fluvial flooding in March 1947, September 1968 (minor flooding), November 1974, December 1981, February 1990 (Loddon), February 1991, December 2000 (Loddon), January 2003 and July 2007. Much of the flooding was more extensive than Flood Zone 3a and has been used to define Flood Zone 2. The historical extents also record several areas of flooding along ordinary watercourses.

5.5.3. The FRMfSW indicates that surface runoff is generally routed towards the numerous rivers and ordinary watercourses in the area. The main area at risk is the settlement at Hurst, where there were a number of drainage incidents in 1993 along the A321. Records from the Parish Council indicate flooding in 2007 was due to lack of maintenance of the drainage ditches and streams.

5.5.4. The north of the Character Area contains permeable bedrock and superficial deposits and the west of the Character Area is underlain by London Clay bedrock, but has extensive permeable superficial deposits along the river valley. These areas may therefore, be expected to be at risk of groundwater flooding. The east of the Character Area, apart from a few scattered patches of permeable sands and gravels, is underlain by low permeability London Clay and therefore, the risk of groundwater flooding is low.

5.6. CHARACTER AREA 5: WINNERSH PARISH AND WOKINGHAM TOWN

5.6.1. Character Area 5 is located in the east of the Borough, is predominantly urban and contains the parish of Winnersh and the town of Wokingham. The Emm Brook runs through the centre of Wokingham and into the north-east of Winnersh and the River Loddon runs along Winnersh's western border. Most of the Character Area is in Flood Zone 1. There are many ordinary watercourses, most of which have significant culverted sections where they flow through towns or under major roads. The Character Area contains the North of Wokingham SDL and the northern part of the South of Wokingham SDL.

5.6.2. The Character Area has experienced fluvial flooding in March 1947, September 1968 (Loddon), November 1974, December 1981, February 1990 (Loddon), February 1991, July 2007 and February 2009 (minor flooding on Loddon only). Most of the flooding along the Loddon was similar to the extent of Flood Zone 3a. In 1968, the flooding affected only a short stretch of river but nevertheless was as wide as Flood Zone 2, which illustrates that the flooding could have been affected by local conditions at the time, such as a blockage. Along the Emm Brook, much of the flooding was similar to Flood Zone 2, although the Emm Brook's flood zones are narrow, so the three higher risk zones are very similar. The Emm Brook flooding also includes its tributary to the north of Wokingham (an ordinary watercourse).

5.6.3. Both the FRMfSW modelling and the historical incident records indicate that parts of the Character Area are very susceptible to surface water flooding. Flood incidents are scattered across the settlements of Winnersh and Wokingham. The part of Winnersh to the west of the railway line (e.g. Greenacres Avenue, Chatsworth Avenue etc.) has a particularly high concentration of historical incidents and the mapping indicates widespread shallow flooding and several locations of deep flooding. Another key area is around Sindlesham where water backs up by the motorway. In Wokingham, the key areas of flooding occur near to Emmbrook School and Blagrove Drive. Again, this is reflected by the FRMfSW deepest flooding. Some areas which the FMfSW modelling show as only limited areas of shallow flooding have also experienced several historical incidents, including locations such as Holmewood Close.

5.6.4. The bedrock geology consists of London Clay in the north and Bagshot Sand in the south-east and this is overlain by scattered deposits of Alluvium and River Terrace Sands and Gravels. Winnersh is the more low-lying end of the Character Area and the three historical incidents, which have occurred in the River Terrace deposits that indicate that local aquifer groundwater levels could be close to the surface in this area.

5.7. CHARACTER AREA 6: PARISHES OF SHINFIELD AND SWALLOWFIELD

5.7.1. Character Area 6 is located in the south-west of the Borough, is predominantly rural and contains the parishes of Shinfield and Swallowfield. The Foudry Brook runs through the north-west of the Character Area, the River Loddon through the centre and along the northeast border and the River Blackwater runs partly along the south border then up to join the Loddon in the centre of the Character Area. Most of the Character Area is in Flood Zone 1. There are numerous ordinary watercourses in the Character Area. The Character Area contains the South of M4 SDL and a small part of the Arborfield Garrison SDL.

5.7.2. The Character Area has experienced fluvial flooding in September 1968 (Blackwater), June 1971 (north end of Foudry Brook), November 1974 (Blackwater), February 1990 (Loddon and Blackwater), February 1991 (Loddon and Blackwater), September 1992 (Foudry Brook), October 1993 (minor flooding at upstream and downstream end of Foudry Brook), January 2003 (downstream end of Foudry Brook) and July 2007 (Loddon and Blackwater). Flooding along the Foudry Brook and River Blackwater has normally been within Flood Zone 3b. Along the River Loddon it has normally been within Flood Zone 3a, although for all three rivers there were occasionally some stretches where flooding has extended into Flood Zone 2. The July 2007 event includes flooding beyond Flood Zone 2, along the main roads into Swallowfield and Riseley, which records from the Parish Council indicate is surface water flooding flowing towards the river.

5.7.3. Historical records, particularly information from Swallowfield Parish Council, indicate that Swallowfield, Riseley and Farley Hill were severely affected by surface water flooding in July 2007, with most of the roads in the villages flooded and also many houses. There were also several incidents in 1993. Spencers Wood also shows several incidents during 1993 and 2007, particularly around Clements Close, although there is no available information regarding severity. In Riseley, the historic records indicate considerably more flooding than the FRMfSW modelling suggests. In this area the modelling seems to predominantly follow the ordinary watercourses, whereas historical records indicate surface runoff is intercepted by and flows down the roads. Farley Hill seems to have a similar problem but there are much fewer incidents. Conversely, in Swallowfield, the historical flooding is well represented by the FRMfSW, which shows water flowing down most of the village roads apart from along the B3349 where flooding is somewhat underestimated and part of Church Road where the modelled flooding is intercepted by a watercourse. In Spencers Wood, there is no historical information on flood paths but the FRMfSW predicts the locations of flooding reasonably well, apart from a single 2007 and two 1993 incidents at the south end of the settlement, but both the 1993 incidents are sewer-related so might be expected to be less directly related to surface runoff paths.

5.7.4. The bedrock geology of the Character Area is London Clay, apart from two areas of Bagshot Sand to the west of Riseley and at Farley Hill. There are some superficial deposits of Alluvium and River Terrace Gravels. However, much of the Character Area directly overlies the low permeability London Clay, including most of Riseley and Spencers Wood and the west part of Swallowfield. These areas are therefore, likely to have a low risk of groundwater flooding and there are no incidents recorded for the Character Area. However, the existence of London Clay within the areas that experiences surface water incidents, is notable and the low infiltration rates., Hence, high runoff volumes and the clay may have exacerbated the surface water flooding. Best practice drainage arrangements, including attenuation of runoff rates, are of key importance in this area.

5.8. CHARACTER AREA 7: PARISHES OF ARBORFIELD AND BARKHAM

5.8.1. Character Area 7 is located in the centre-east of the Borough, is mainly rural and contains the parishes of Arborfield and Barkham. The River Loddon runs along its western border, with the Barkham Brook running from Barkham in the centre of the Character Area, to join it as a confluence. Most of the Character Area is in Flood Zone 1and there are many ordinary watercourses in the Character Area. The Character Area contains the northern part of Arborfield Garrison.

5.8.2. The Character Area has experienced fluvial flooding in February 1990 (Loddon), February 1991 (Loddon) and July 2007 (Loddon). The July 2007 flooding was similar to Flood Zone 3a, but the earlier events both extended into most of Flood Zone 2. Whilst no historical flooding has been recorded along Barkham Brook according to the Environment Agency records, the Barkham Parish Council records indicate flooding at the bridges in Barkham.

5.8.3. Historical surface water flooding has mainly been along the main rivers and ordinary watercourses in the Character Area, where surface runoff would be expected to concentrate and the historical flooding locations are well predicted by the FRMfSW. Key locations are indicated as being along Walden Avenue, Poperinghe Way, Langley Common Road and Valon Road.

5.8.4. The majority of the Character Area is underlain by London Clay, although there is some Bagshot Sand to the east of the Character Area and a small area west of Arborfield Garrison. There are a few deposits of alluvium and gravels, but most of the Character Area overlies the London Clay directly. Therefore, there is very low risk of groundwater flooding for most of the Character Area.

5.9. CHARACTER AREA 8: PARISHES OF FINCHAMPSTEAD AND WOKINGHAM WITHOUT

5.9.1. Character Area 8 is located in the south-east of the Borough, is mainly rural and contains the parishes of Finchampstead and Wokingham Without. The River Blackwater runs along its southern border and the upstream reaches of the Emm Brook and tributaries are in the north east of the Character Area. Most of the Character Area is in Flood Zone 1. There are many ordinary watercourses in the Character Area, apart from the area of high ground in the centre of Finchampstead Parish. The Character Area contains the southern part of the South of Wokingham SDL and the southern part of Arborfield Garrison SDL.

5.9.2. The Character Area has experienced fluvial flooding in March 1947, September 1968 (Blackwater) February 1990 (Blackwater) and July 2007. The flooding extended into Flood Zone 2 along several stretches of the rivers.

5.9.3. Several incidents of surface water flooding occurred in July 2007, affecting properties at the junction of Reading Road and New Mill Road, properties in the vicinity of north Kiln Ride to Cypress Close and properties along a valley roughly following the line of Finchampstead Road to Gorse Ride to Nash Grove Lane. There is another valley in Pinewood (the part of Crowthorne within Wokingham Borough) following the line of Hillary Drive, along which surface water flooding occurred in both 1993 and 2007. These areas are all picked up as key surface runoff routes by the FRMfSW modelling.

5.9.4. The geology of the Character Area is quite permeable. Most of the Character Area lies over sandstone bedrock of various types (Bagshot, Windlesham and Camberley). In the far west and north-east of the Character Area there is London Clay bedrock, which is low permeability. However, much of the north-east clay is overlain by the permeable superficial deposits of alluvium and gravels, which occur particularly in the east of the Character Area. In the west, more of the London Clay remains exposed, although there are superficial deposits along the Blackwater valley. Nevertheless, overall, there is a risk of groundwater flooding for most of the Character Area. An incident has been recorded in the Bagshot Sand, located in the north of the Character Area.

6

GUIDANCE FOR FLOOD RISK ASSESSMENT

6. GUIDANCE FOR FLOOD RISK ASSESSMENT

6.1. THE REQUIREMENT FOR FLOOD RISK ASSESSMENTS

6.1.1. A site-specific Flood Risk Assessment (FRA) is an integral part of the planning application for new and redevelopment projects. An FRA is required for all proposed developments located:

- Partially or wholly within Flood Zone 2 or 3; or
- Within Flood Zone 1 and covering an area greater than 1 hectare, or resulting in the provision of 10 or more residential dwellings; or,
- Within Flood Zone 1 and at risk from other sources of flooding.

6.1.2. Figure 3, overleaf, provides a summary of the decision process that shall be adopted in determining the requirements for a site-specific FRA.

6.1.3. The detail provided in the FRA should be based on current flooding information and be commensurate with the risk of flooding to the proposed development. For example, where the risk of flooding to the site is negligible, there is little benefit to be gained in assessing the potential risk to life and/or property as a result of flooding. Rather, emphasis should be placed on ensuring that runoff from the site is controlled safely on-site and does not exacerbate flooding lower in the catchment.

6.1.4. The Environment Agency should be consulted on any development proposals that fall into any of the following:

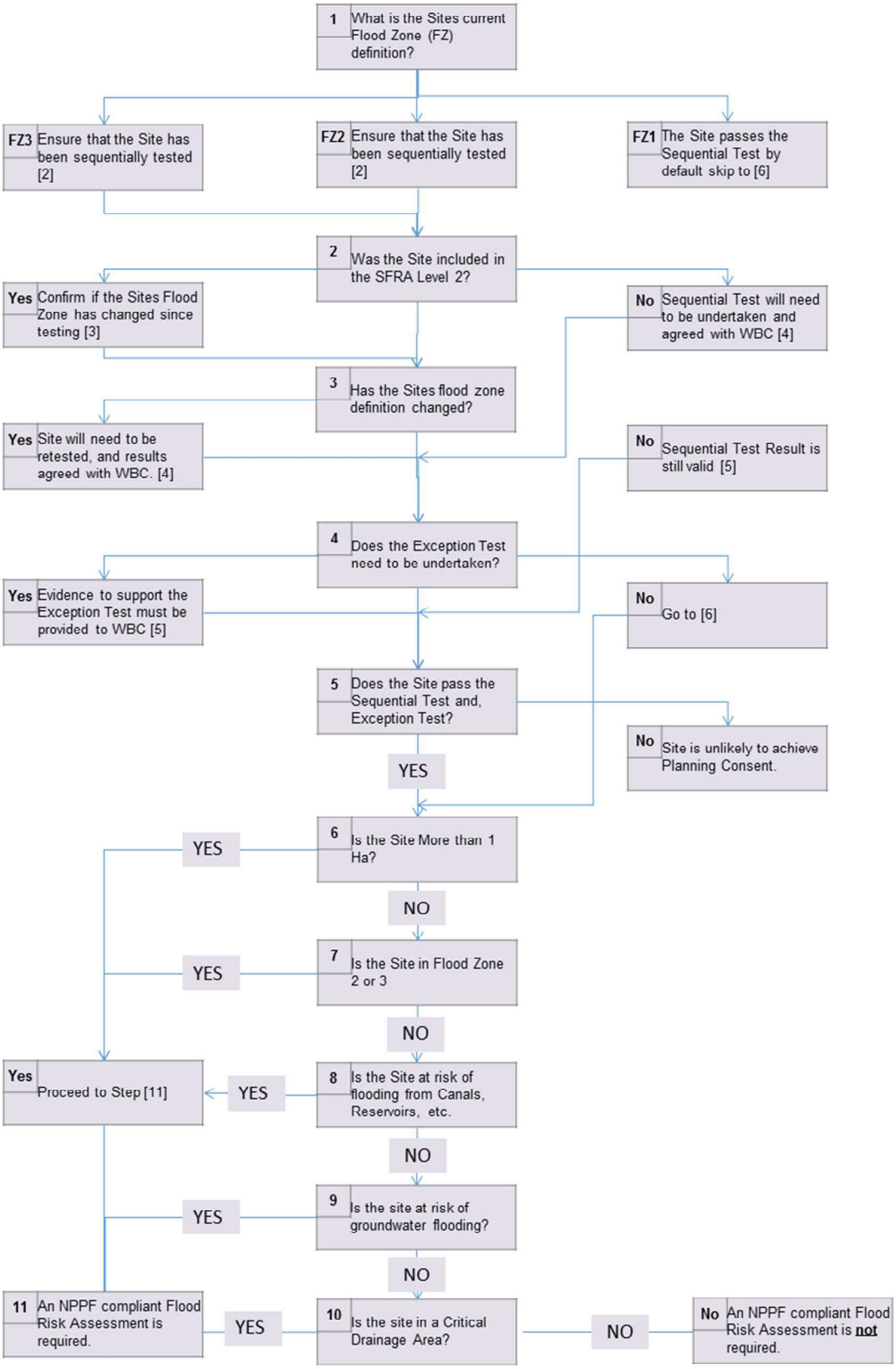
- Are within Flood Zone 2 or 3.
- In an area at risk of groundwater flooding.
- Within 20m of a flood defence or Main River.

6.1.5. All proposed sites that are not allocated as part of the Borough LPU will need to demonstrate that the Sequential Test has been applied (in accordance with the NPPF and the requirements detailed below) and where necessary, pass the Exception Test.

6.1.6. The FRA must demonstrate how flood risk will be managed within the site, without increasing flood risk to the surrounding area. The Council will make their decision based on the evidence within the FRA as to whether the development is acceptable.

6.1.7. As part of any development proposals consideration for the safeguarding of land for current and future flood risk management purposes, SuDS, green infrastructure, habitat creation programmes etc, shall be demonstrated.

Figure 3: FRA Decision Process



6.2. ADDITIONAL GUIDANCE

6.2.1. This chapter reflects best practice in terms of the information that should be provided within a FRA. In addition, it is recommended that the resources provided by the Environment Agency are utilised when preparing a FRA.

- To assist local planning authorities, the Environment Agency has produced standing advice to inform on their requirements regarding the consultation process for planning applications on flood risk matters. Full details of their Flood Risk Standing Advice can be found on the website www.gov.uk/government/organisations/environment-agency.
- The Environment Agency is a highly recommended source of information to inform the development of detailed FRA. Their external relations team should be contacted as early as possible to source information relating to (for example) historical flooding and hydraulic modelling. It is emphasised that the information provided within the SFRA is the best available at the time of writing. More up to date information may be available, and contact should always be made with the Environment Agency at an early stage to ensure that the detailed site-based FRA is using the most current datasets, avoiding abortive work.
- It is recommended that where acceptable to all parties, a draft of the detailed FRA is provided to the Environment Agency for review and comment before being submitted with the planning application, thereby reducing potentially costly delays to the planning process.

6.3. CRITERIA TO ASSESS IN FLOOD RISK ASSESSMENTS

6.3.1. FRAs must include an assessment of the criteria below, where relevant to the specific potential development.

FLUVIAL FLOODING

6.3.2. Fluvial modelling results should be analysed to ascertain the vulnerability of the development to flooding over the lifetime of the development (including the potential impacts of climate change). Land uses should be allocated which are compatible with the flood zone.

6.3.3. This SFRA contains the most up-to-date information at the time of writing. However, flood mapping is continually updated; the latest Environment Agency flood zones are published online at *www.flood-warning-information.service.gov.uk/long-term-flood-risk.* Local food extent maps and peak flood levels can normally be obtained from the Environment Agency on request.

- Further information such as flows, velocities and hazard may be available where detailed flood risk mapping has been carried out.
- Where detailed modelling is not available and dependant on the nature and scale of the development, hydraulic modelling by suitably qualified specialists may be required to determine the risk of flooding to the site and to ensure the proposed development does not increase flood risk.
- The nature, scale and flood risk to a development will also dictate whether detailed hydraulic modelling by a suitably qualified specialist is required to determine the impact of climate change to the proposed development, to ensure site users remain safe for the lifetime of the development.

SURFACE WATER

6.3.4. Consideration of flood risk from surface water must include both the existing risk and the potential increase caused by the development.

- The existing flood risk should be assessed based on the Environment Agency's FRMfSW and historic records of surface water flooding at the site. This information should be used in conjunction with local information where available, including the drainage system and detailed site topography.
- Existing overland flow paths must be maintained through the site. For constrained sites where development is required in areas through which an existing overland flow path is indicated, the development must be designed to continue to allow overland water to flow, such as through the use of voids beneath the building.
- The proposed development must not result in an increase in maximum flood levels within adjoining properties. This may be achieved by ensuring that the existing building footprint is not increased, that overland flow routes are not truncated by buildings and/or infrastructure, or hydraulically linked compensatory storage is provided within the site (or upstream).
- Sustainable drainage (SuDS) techniques are employed to ensure surface water runoff from the proposed development does not exceed greenfield runoff rates and volumes.
- For brownfield sites where it is not feasible to restrict runoff to the greenfield rate and volume, the proposed development must deliver an improvement on the existing conditions that is as close as feasibly possible to the rate and volume associated with the greenfield site.
- Part H of the Building Regulations: Drainage and Waste Disposal establishes a hierarchy for surface water disposal, which should be adopted for the discharge of surface water from the proposed development. This hierarchy stipulates that surface water runoff not collected for reuse must be discharged to one or more of the following in order of priority:
  - Discharge into ground (infiltration); or, where not reasonably practicable,
  - Discharge to a surface water body; or, where not reasonably practicable,
  - Discharge to a surface water sewer, highway drain, or another drainage system; or, where not reasonably practicable,
  - Discharge to a combined sewer.
- The surface water drainage strategy must be designed to remain operational during all flood events up to and including the 1% AEP plus climate change event (20% to 40%). For developments partially within Flood Zone 3, SuDS must be used to manage surface water runoff on the site. However, any SuDS features must also be located in areas outside of Flood Zone 3 extents. Where this is not feasible, or where the site is wholly located in Flood Zone 3, the proposed development must utilise blue / green roofs and green walls to manage surface water runoff, where feasible. Checks shall be undertaken on the attenuation capacity of the system to account for the impacts of a surcharged outfall due to fluvial flooding.

- An estimation of the volume of storage needed to achieve the above requirements should be undertaken. The *Preliminary rainfall runoff management for developments*[10] guidance provides a simplified methodology for calculating a site's greenfield discharge rates, including an initial estimate of the storage volumes necessary to maintain the developed site's discharge at greenfield rates and volumes. For brownfield sites, proposed developments must demonstrate an improvement on the existing rates and volumes and it is recommended that runoff is reduced as near to greenfield as is practicable, to achieve betterment of surface runoff risk subject to a de minimis of 5 l/s.

GROUNDWATER

6.3.5. The risk to the proposed development from groundwater flooding must also be considered, including the potential offsite increase in groundwater flood risk that may be created by the development.

- Where the proposed development is identified as being in an area where there is a possible risk of groundwater flooding, seasonal groundwater monitoring must be undertaken for a suitable period to establish the risk of flooding from this source to the proposed development. The main source of information to determine whether a site is at risk of groundwater flooding is likely to be geological maps. Permeable soils with high groundwater levels are most likely to pose a risk of groundwater flooding.
- If the permeable geology is overlain by an impermeable (very low permeability) layer, then this can provide a measure of protection by preventing groundwater escaping through it. However, it should be considered that if this layer is thinner than the depth of excavation due to development, then the breach in the impermeable layer may set up a flow path to the surface.
- Where the site is shown to be underlain by shallow groundwater, the surface water drainage system must consider the impact that groundwater may have upon the effectiveness of the SuDS system.
- Whilst developers should normally consider infiltration as their first preference for disposing of surface runoff, where the water table is close to the surface then infiltration may no longer be viable both because the lack of sufficient unsaturated depth of soil for water to soak into may prevent the device from functioning properly. Furthermore, increased infiltration (e.g. from a brownfield site which was previously impermeable) could increase the risk of groundwater flooding.
- If it is proposed to discharge surface water to ground via infiltration, evidence must be provided to demonstrate that the infiltration rates associated with the site are suitable for discharge. In some cases, borehole or trial pit logs may be available for the site or the immediate vicinity, which provides a detailed source of information on the underlying soil and groundwater level. It is important to remember that these only give a 'snap shot' of the groundwater level on a given day. For example, if the log is taken in mid-summer it is likely to show a low groundwater level due to low rainfall and high evaporation rates, whereas the level is likely to be considerably higher in winter. Evidence may also be provided in the form of geotechnical investigations, infiltration tests and records of groundwater monitoring.

[10] Defra/Environment Agency (2005) R&D Technical Report W5-074/A/TR1 Preliminary rainfall runoff management for developments (Revision D)

- If the proposed development is located in a Source Protection Zone (SPZ), the associated implications and risks must be considered.
- Where a high level of groundwater flood risk is identified, it is recommended that finished floor levels are raised and basement dwellings are not permitted.

SITE LAND USES

6.3.6. The vulnerability of a development is dictated by its use. The NPPF Flood Risk and Coastal Change PPG groups potential uses into five vulnerability categories, which are as follows: essential infrastructure, highly vulnerable, more vulnerable, less vulnerable and water compatible development. The vulnerability of a development dictates its suitability for use in each flood zone and determines whether the Exception Test must be applied and passed.

6.3.7. All future development in the Borough must demonstrate that the use is suitable for the flood zone in which it is located, in accordance with Table 2 and 3 of the NPPF Flood Risk and Coastal Change PPG (replicated in this SFRA as Table 5 and Table 6). Where suitable sites at lower risk of flooding are not available, evidence must be provided to demonstrate that flood risk to people and property will be managed to ensure it is safe for its lifetime, without increasing flood risk elsewhere and where possible reduce flood risk in the Borough.

6.3.8. Where there is more than one flood zone and a mixed land use development, the sequential approach should also be followed within the site, allocating the most vulnerable land uses to the lowest flood risk area within the site.

6.3.9. Development lifetime is dictated by the proposed use. For example, residential development should be considered to have a minimum lifetime of 100 years, whereas non-residential development lifetime is dependent on the type and location of the development. Within the Borough all non-residential development should be considered with a minimum life of 60 years, unless robust evidence is available to demonstrate otherwise.

BASEMENTS

6.3.10. Basement dwellings within flood affected areas (fluvial and other types of flooding) should generally be discouraged. Best practice guidance on basements is as follows:

- Basements are classified as ‘highly vulnerable’ so are not permitted within Flood Zone 3a or 3b and have to pass the Exception Test within Flood Zone 2. Where basements are constructed, the design must ensure they are safe including unimpeded access. Access points must be situated between 300mm and 900mm above the 1% AEP plus climate change flood level (depending on the specific development) and waterproof construction to at least this level, to avoid seepage during flooding conditions.
- Groundwater is a particularly important consideration when constructing basements. If the water table is near to the surface, the basement may intercept flow resulting in groundwater backing-up outside the walls. Where the build-up in pressure can force water through cracks into the building, it can lead to seepage and may undermine the structural integrity of the building. Where basements are constructed, they should have adequate lining, drainage and ventilation.
- It must also be considered that backing-up of water by a new basement may affect nearby existing buildings on the up-gradient side, this would need to be effectively mitigated as part of the building design.

- It should be noted that similar problems can be caused by surface water runoff, as water can be trapped by the building and cause excessive infiltration into the ground nearby. This is most particularly a problem for buildings located where the land slopes down towards them, as significant amounts of water may be collected. Where buildings are located in the overland flow path of surface water runoff, measures should be taken to ensure that water can be routed around the building and it may be advisable to cut a swale into the hill slope to intercept the water and prevent it from collecting at the building walls.
- Where problems from surface water or groundwater are severe, it is advisable not to permit basement dwellings.

SITE TOPOGRAPHY

6.3.11. The FRA should include details of existing site levels, proposed site levels and proposed ground floor levels. All levels should be stated relevant to Ordnance Datum. It is recommended that FRAs include a map of the site's topography with flood levels plotted out, as this is a useful method for outlining more accurate flood extents to assist with the sequential approach on site. Where detailed modelling is not available, flood depths may be estimated by comparison of the extents with the topography.

6.3.12. For some sites, ground reprofiling may be considered in order to raise part of the site above flood levels. This is normally carried out to reconfigure the site to a more convenient topography. It is important to maintain the flood storage volume and also ensure that conveyance from the river to the storage area is maintained. Where land raising reduces the storage volume on site, compensatory storage must be found elsewhere. Other planning considerations such as potential archaeological, heritage and contaminated land constraints must be assessed if ground reprofiling is considered.

FLOOD STORAGE/CONVEYANCE ROUTES

6.3.13. Any additional built development footprint within a flood risk area will need to ensure it does not negatively impact upon floodwater flow conveyance or the ability of the floodplain to store water. The impediment of flood water and/or the reduction of the capacity of the floodplain to store water, has the potential to change the flood risk both to the proposed development site and the wider area by changing the area(s) where flood water flows and collects.

6.3.14. Where necessary, key flow routes should be identified for fluvial and surface water drainage systems and these should be protected from obstruction. This is essential for Flood Zone 3b, where it has been specifically designated to provide flow routes or storage for water in times of flood. For constrained sites where development must be located in an existing overland flow path, the development must be designed to continue to allow water to flow. For example, through the use of voids beneath the building or raising the building on a stilted construction.

6.3.15. Development must not itself, or cumulatively with other development, materially reduce the capacity of the existing floodplain to store water. If the capacity of the floodplain to store water is further reduced, the water that can no longer be stored in the existing floodplain will flood areas that were not previously at risk of flooding.

6.3.16. All development proposals that involve altering the floodplain must demonstrate how the overall volume of the floodplain is not altered on a level-for-level basis, based on the 1% AEP plus climate change flood level. The area that will compensate for the lost floodplain, must provide a minimum of 5% more storage than the area that will be lost as a result of the proposed development on a level-for-level basis. Alterations to the floodplain must be tested using detailed hydraulic modelling undertaken by a suitably qualified engineer.

6.3.17. In some cases, it may be reasonable to design the flood storage area as an open space underneath the building. However, in these cases it is critical that legal agreements (for example, a Section 106 agreement or unilateral agreement) be put in place to prevent inappropriate use that would obstruct the void space. It is not recommended for residential development, as there is a high risk that homeowners will not maintain the space. Car parks are a typical use of the void space, in which case there must be an adequate flood warning system in place, to allow users to remove their vehicles safely.

6.3.18. Where car parks are used as temporary flood storage areas, ideally flood depths should not exceed 300mm, since vehicles can be moved by water of greater depth. Where greater depths do occur then the car park should be designed so as to prevent vehicle floatation. The velocity of flood water should also be considered. Clear and visible signage should be in place to notify drivers of the susceptibility to flooding and flood warning should be available to give car owners time to move their vehicles safely.

RESIDUAL RISKS

6.3.19. Use of the sequential approach to avoid development in flood risk areas is key to managing flood risk. Where avoidance is not possible, flood risk management measures such as flood defences and flood storage help reduce the risk of flooding and may be used as measures to enable the site to pass the Exception Test. Nevertheless, it must be recognised that flood risk can never be completely eliminated; the remaining risk is known as residual risk. Residual risk includes the following:

- The failure of flood management infrastructure such as the breach of a raised flood defence, blockage of a surface water conveyance system, failure of a flap-valve or similar device, overtopping of an upstream storage area, or failure of a pumped drainage system,
- A severe flood event that exceeds a flood management design standard, such as a flood that overtops a raised flood defence, or an intense rainfall event that the piped drainage cannot manage.
- General uncertainties inherent in the prediction of flooding. It is difficult to quantify uncertainty. The flood zones underpinning the Wokingham Borough SFRA are based upon a collation of data from various sources. It is important to recognise that all flood risk modelling requires core assumptions and the use of empirical estimations, relating to (for example) rainfall distribution and catchment response.

6.3.20. The FRA should demonstrate that residual risks of flooding are acceptable. Measures may include the following:

- Raising the ground floor levels of buildings.
- Flood resistant, resilient and repairable building design.
- Safe access.
- Effective flood warning and emergency planning.

6.3.21. It is essential that developers thoroughly review the existing and future structural integrity of formal and informal defences (if present) upon which the development will rely (over the lifetime of the development, including assurance for their operation and maintenance).

SAFE ACCESS/EGRESS

6.3.22. The FRA should consider access to and from the site during a flood event, as follows:

- Ideally access should be 'dry' (i.e. above the 1% AEP plus climate change flooded area).
- Where dry access is not possible, limited depths of flooding may be acceptable, depending on the flood velocity and risk of debris and the vulnerability of people on site. The route must be adequately signposted and avoid hazards such as chambers whose covers may be removed due to surcharge under flood conditions.
- Vehicular access to allow emergency services to safely reach the development during the 1% AEP plus climate change flood conditions is also recommended. Sites must not rely on helicopter (air) evacuation since they may not be able to operate at all times of day or in all weather conditions.
- Where SuDS devices involving open water (such as ponds and swales) are constructed, these should be located so that they do not impede safe access and egress.
- The *Supplementary Note on Flood Hazard Ratings and Thresholds for Development Planning and Control Purposes – Clarification of Table 13.1 of FD2320/TR2 and Figure 3.2 of FD2321/TR1*and published by the Environment Agency in May 2008, provides further essential guidance. This can be viewed at www.environment-agency.gov.uk.

SITE EVACUATION PLAN

6.3.23. For all sites at risk of flooding, the means of evacuation must be detailed in a site evacuation plan to demonstrate that all site users will not be at risk during a flood event. The plan will need to demonstrate how site users are able to evacuate the site without emergency assistance during extreme flood events up to the 1% AEP plus climate change event, either by foot or vehicle. The vehicular access route for the site should be suitable for use by the emergency services and be designed to be functional for the lifetime of the development.

6.3.24. The Borough will approve site evacuation plans as part of its Emergency Planning role. The plans must be in accordance with the Borough's *Major Incident Plan*[11] that details the emergency planning systems and procedures in the Borough. Site specific evacuation plans must be consistent with the framework set out in the Major Incident Plan, to ensure a safe and consistent response to flooding across the Borough.

FLOOR LEVELS

6.3.25. To ensure damage to property is minimised, ground floor levels should be raised above the 1% AEP plus climate change flood level, by a specified amount known as the 'freeboard'. The freeboard is generally between 300mm and 900mm, depending on the vulnerability of the site use and flood risk.

6.3.26. If no climate change data is available then a precautionary freeboard of 600mm above the present-day 1% AEP floodwater level should be used for all building types.

BUILDING CONSTRUCTION

6.3.27. For some development proposals located in areas of flood risk, it may not be possible to raise floor levels due to other constraints. So, the options of flood resistant, resilient or repairable construction should be considered to ensure site users are not at risk from flooding for the lifetime of the development. Such measures may include raising electrical sockets and appliances above the flood level, flood proofing of external building facades, or other property level protection.

6.3.28. These flood management measures are most likely to be acceptable for 'water-compatible' and 'less vulnerable' uses, where temporary disruption is acceptable and flood warning is provided so that flood resistance elements (e.g. barriers) can be put in place and the building evacuated if necessary. They may also be suitable as measures to mitigate residual risk.

6.3.29. All flood mitigation measures should be designed with an allowance for climate change. This provides a sustainable approach to the potential impacts that climate change may have upon the Borough over the next 100 years, ensuring that future development is considers the possible increases in flood risk over time.

6.3.30. For further information on flood resilient measures refer to '*Improving the flood performance of new buildings: flood resilient construction*'[12] and the Flood Risk and Coastal Change PPG.

6.4. FLOOD RISK ASSESSMENT GUIDANCE

6.4.1. The following section provides guidance on the information that should be provided as part of a FRA for sites in each of the Flood Zones to demonstrate that the preceding requirements have been addressed. The level of information provided in a FRA should be commensurate with the risk of flooding to the proposed development and the following list of requirements is far from exhaustive.

6.4.2. The following requirements as a minimum should be prepared as part of all FRAs:

- An assessment of the risk to and from the proposed development from all relevant sources of flooding and details of how the potential risk of flooding has been accounted for in the proposed development design to minimise the risk to development users.
- The potential of the development to increase flood risk elsewhere through the addition of hard surfaces, the effect of the new development on surface water runoff and the effect of the new development on depth and rate of flooding to adjacent and surrounding property. This will require a detailed assessment to be carried out by a suitably qualified engineer. It is emphasised that the detailed assessment of potential impacts elsewhere should not be limited (in a geographical sense) to the Borough. Future development within the Borough may adversely affect sites within adjoining boroughs and it is essential that this is mitigated.
- Details of the SuDS features that will be applied at the site, with appropriate justification for the selection.

[11] Wokingham Borough Council (2012) Major Incident Plan, available online at: http://www.wokingham.gov.uk/community-and-safety/emergencies/prepare-for-an-emergency/

[12] Improving the flood performance of new buildings: flood resilient construction (2007) Department for Communities and Local Government

- A description of how surface water will be collected and dealt with across the development site by the proposed SuDS techniques, including what volumes are to be stored.
- Details of how the SuDS features to be used at the site will be designed to account for climate change and the topographical, groundwater and geological conditions at the site.
- A description of the water quality treatment measures applied to surface water runoff as it drains the site.
- Details of the proposals for the adoption and maintenance of the entire drainage system(s). For major developments[13] a written agreement in principal from the adopting/maintaining organisation must be provided.
- Identification of the destination of discharge (in accordance with Building Regulation Part H hierarchy) with appropriate justification for the selection and identification of proposed points of connection(s).
- Evidence of consultation regarding drainage discharge locations from key third parties whose systems the proposed drainage system will need to connect / impact (Environment Agency, Lead Local Flood Authority, Thames Water or adjacent landowner). Wherever relevant or possible, confirmation (at least in principle) of an agreement to connect and discharge (including the location and rate).
- Where applicable, a description of how the proposed system(s) will deal with surface water overland flow flooding originating from adjacent areas, developed or undeveloped.
- Where applicable, an explanation of why it is not reasonably practicable to achieve one or more of the non-statutory technical standards for sustainable drainage systems (March 2015).
- Where proposing discharge to ground, evidence to support proposed infiltration rates used in initial calculations. This should include nearby borehole logs, geological mapping and if available any geotechnical investigations, infiltration tests, and records of groundwater monitoring. Infiltration testing should be compliant with BRE Digest 365 Soakaway Design. Consideration shall also be given to the implications of any local SPZs.
- Where applicable, identification of any mechanical or electrical features necessary for the effective operation of the drainage strategy.
- Where the proposed development is identified as being in area where there is a possible risk of groundwater flooding, groundwater monitoring results must be submitted with the FRA. The FRA must also consider the impact that groundwater may have upon the effectiveness of any adopted SuDS system.
- A clear and concise statement summarising how the proposed development or redevelopment has contributed to a positive reduction in flood risk within the Borough.

[13] Developments of 10 dwellings or more; or equivalent non-residential or mixed development (as set out in Article 2(1) of the Town and Country Planning (Development Management Procedure) (England) Order 2010)

6.4.3. In addition to the above requirements, proposed development sites located in Flood Zone 2 should also meet the following points:

- The assessment must detail the vulnerability of the development to flooding over its lifetime, including the potential impacts of climate change for all sources of flooding. The potential impacts of climate change on flood risk associated with the proposed development must be hydraulically modelled in accordance with the appropriate allowances set out in the Environment Agency *Flood Risk Assessments: Climate Change Guidance*. The Environment Agency may have carried out detailed flood risk mapping (with respect to fluvial flooding) within localised areas that could be used to underpin this assessment. All modelling must be undertaken by suitably qualified engineers. The extent of hydraulic modelling required will be proportionate to the nature and scale of the development.
- Details of existing site levels, proposed site levels and proposed ground floor levels. All levels should be stated relevant to Ordnance Datum.

6.4.4. As well as the requirements detailed in Section 6.4.2 and 6.4.3, development sites in Flood Zone 3a and Flood Zone 3b should meet the following requirements:

- Details of floodplain compensation requirements for the proposed development, including calculations demonstrating that level-for-level and volume-for-volume floodplain compensation can be provided, plus a minimum of 5% additional volume to help mitigate flood risk offsite.
- A plan indicating the location of the area in which compensation is to be located and a cross-section demonstrating that level-for-level and volume-for-volume compensation can be provided.
- Any compensatory floodplain storage will need to be supported by suitable environmental and ecological assessments. This will need to demonstrate that there is no net loss of biodiversity resulting the proposed development.

6.4.5. An assessment of the flood regime accounting for the presence of any formal and de-facto flood defences. It is recommended this assessment is undertaken using hydraulic modelling undertaken by a suitably qualified engineer. Details of the integrity of any defences must be provided to demonstrate that the structural integrity of the defence throughout the lifetime of the proposed development. Where this is not confirmed, the proposed development must be designed to account for the flood risk to the site without defences. Details of a potential defence failure must be provided, along with details of how users of the proposed development will remain safe.

7

SUSTAINABLE SURFACE WATER MANAGEMENT

7. SUSTAINABLE SURFACE WATER MANAGEMENT

7.1. BENEFITS OF SUSTAINABLE DRAINAGE SYSTEMS

7.1.1. New developments are now required to manage surface water runoff so that there is no post development increase in the peak rate and volume. Consequently, no increase in surface water flood risk through the design and implementation of contemporary Sustainable Drainage Systems (SuDS) wherever possible[14].

7.1.2. SuDS are used to manage surface water drainage in a way that mimics the predevelopment drainage regime, sometimes with betterment. The sustainable management of rainfall (surface water) is considered an essential element of reducing future flood risk to both the site and its surroundings. Reducing the volume and rate of discharge from urban sites to greenfield conditions is one of the ways of reducing and managing flood risk within the Borough. Options for reuse of surface water within developments should be considered as part of the strategy, to reduce the consumption of potable water resources (i.e. rainwater harvesting).

7.1.3. The integration of SuDS into a site's masterplan design can also provide broader benefits, including an improvement in the water quality of runoff discharged from the site, the capture and re-use of surface water runoff for non-potable uses and the provision of amenity green space areas offering recreation and/or aesthetic benefits and opportunities to enhance biodiversity. In the current version of the industry standard and best practice SuDS Manual (CIRIA C753), the 'Four Pillars' of contemporary SuDS are Quantity, Quality, Amenity and Biodiversity.

7.1.4. Where it is envisaged that developments in the Borough will discharge to the public sewer network (either directly, or indirectly), early engagement with Thames Water should be undertaken.

7.1.5. SuDS may improve the sustainable management of water for a site by the following:

- Reducing peak flows to receiving watercourses or sewers and potentially reducing the risk of flooding downstream.
- Reducing volumes and the frequency of water flowing directly to receiving watercourses or sewers from developed sites.
- Improving water quality over conventional surface water sewers by removing pollutants from diffuse pollutant sources.
- Reducing potable water demand through rainwater harvesting and reuse where feasible.
- Providing additional amenity through the provision of public open space and wildlife habitat.
- Replicating natural drainage patterns, including the recharge of groundwater so that base flows are maintained.
- Contribute to the enhanced amenity and aesthetic value of developed area.
- Provide habitats for wildlife in urban areas and opportunities for biodiversity enhancement.

7.1.6. In catchment terms, the cumulative effect of applying SuDS to sites will have a significant benefit and provide overall betterment.

7.2. CONSTRAINTS ON THE USE OF SUDS

GEOLOGY

7.2.1. The appropriate application of a SuDS scheme to a specific development is heavily dependent upon the geology of the site (and its surroundings) as well as the local groundwater regime. For example, infiltration techniques are generally most suitable in areas of permeable soils and geology.

7.2.2. Where infiltration SuDS are used, they should be in accordance with the following conditions:

- A shallow water table will compromise the operation of an infiltration system and it is essential that groundwater levels (in addition to soil permeability) are assessed on site as an integral part of the design process. The base of any infiltration structure should be at least 1m above the highest recorded groundwater level.
- SuDS should not be constructed through contaminated material, unless an appropriate risk assessment has shown that the disposal complies with the Groundwater Regulations 2009 or site-specific environmental quality standards agreed with the Environment Agency.
- SuDS should be as shallow as possible to allow maximum attenuation and biodegradation of pollutants. A minimum 1m metre unsaturated zone shall be maintained from the base of the device to the maximum seasonal water table for the site.
- Drainage of highway or parking areas will usually require additional safeguards such as silt-trapped gullies or a suitably sized proprietary separator and must be kept separate from drainage systems receiving clean roof water.
- The use of borehole soakaways will only be acceptable subject to written agreement from the Environment Agency.

An overview of the infiltration potential of the Borough is shown in Appendix A.9.

TOPOGRAPHY AND MASTERPLAN

7.2.3. The topography of the site is also an essential consideration for the selection of an appropriate SuDS system. For example, areas of steeply sloping ground are generally unsuitable for techniques that rely on the storage and/or infiltration of runoff on the surface.

7.2.4. An overview of the topography of the Borough is shown in Appendix A.6.

7.2.5. It should be acknowledged that there are occasions where the proposed masterplan of a development site will be a constraint to the use of above ground SuDS structures. This can be overcome through engagement and consultation to include the design and implantation of buried proprietary SuDS structures, such as flow controlled detention tanks (i.e. oversized pipes, box culverts and geocellular tanks).

FURTHER CONSTRAINTS

7.2.6. Other constraints that may restrict or preclude the use of a particular SuDS technique, or that may impose additional requirements on the performance of a particular system are identified within Chapter 8 of CIRIA C753 'The SuDS Manual'.

[14] The Secretary of State for Communities and Local Government (2014) House of Commons Written Statement (HCWS161) – Sustainable Drainage Systems, available at: http://www.parliament.uk/documents/commons-vote-office/December%202014/18%20December/6.%20DCLG-sustainable-drainage-systems.pdf

7.3. USING SUDS IN WOKINGHAM BOROUGH

7.3.1. Wokingham Borough Council prepared the *Wokingham SuDS Strategy*[15] in 2016 to guide developers and their design teams in the use of SuDS in the Borough. This document is to assist when masterplanning all major developments, to ensure surface water runoff within the development is discharged in a sustainable manner for the lifetime of the development. The Strategy is centred on ensuring SuDS are considered as early as possible in the site masterplanning process, to ensure they are successfully integrated into a development. This Strategy also provides advice to help mitigate flood risk, improve water quality and address biodiversity concerns in the wider catchment.

7.3.2. The Strategy is supported by the *SuDS Technical Guide* which sets out the technical requirements and expectations for SuDS in the Borough.

7.3.3. The Strategy and Technical Guide builds on the guidance and advice for designing SuDS in the *Wokingham Borough Sustainable Design and Construction Supplementary Planning Document*[16] (SPD), in paragraphs 12.9 to 12.13 of Chapter 12 (Flood Risk Management).

7.3.4. The Strategy and the requirements in the Sustainable Design and Construction SPD must be adhered to when designing and implementing SuDS in the Borough.

7.3.5. The design of SuDS for incorporation into the Strategic Development Locations (SDL) must also be in accordance with the SDL SPDs[17] and include requirements for a comprehensive system for water management (fluvial and surface water) to be provided, which takes account of existing SDL features.

7.3.6. Appendix A.9, infiltration potential, provides an overview of the Borough in terms of likely infiltration capacity that will affect which SuDS may be appropriate. This should be based on the following information:

- The **most permeable** areas in the Borough are in the far north, around north Aston, Remenham Hill and Cockpole Green and south-east of Ruscombe, which corresponds generally to the areas overlying chalk geology. The west of the Borough around Woodley and where the Foudry Brook exits the Borough, the south-east, around Barkham, Finchampstead and Pinewood and along the course of the Lower Loddon, are also reasonably permeable such that infiltration is likely to be viable.
- The **least permeable** areas in the Borough are a large swathe from the south-west to the centre-east of the Borough, encompassing settlement areas such as Spencers Wood, Arborfield Garrison and parts of Wokingham and a second area around Crazies Hill. These generally correspond to areas over Clay geology, which has very low permeability such that infiltration is likely to be too constrained to facilitate the sustainable drainage of surface water runoff. Therefore, in these areas it will probably be necessary to use flow-controlled attenuation SuDS techniques, to store the water during the storm event and then discharge it slowly into a nearby watercourse.

7.3.7. The infiltration potential map only provides an overview of the Borough and therefore, should only be taken as an approximate indication. Considerable variation in soil characteristics can occur at the local scale and it is recommended that a site-specific investigation be carried out during the FRA.

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[15] Wokingham Borough Council (2016) Wokingham SuDS Strategy, available online at: www.wokingham.gov.uk/_resources/assets/attachment/full/0/399029.pdf

Furthermore, other factors must also be considered, such as the depth to the water table. If there is insufficient depth for both the size of the infiltration device and the base of any infiltration structure at least 1m above the highest recorded groundwater level, then infiltration SuDS are unlikely to be viable.

7.3.8. As a further consideration, Appendix A9 also includes mapping of Groundwater Source Protection Zones (SPZ). SPZs are defined for groundwater sources such as wells, boreholes and springs used for public drinking water supply to show the risk of contamination from any activities that might cause pollution in the area. Three main zones are defined as follows:

- The inner protection zone (Zone 1) indicates areas from where pollution can travel to the groundwater source within 50 days or is at least a 50m radius.
- The outer protection zone (Zone 2) indicates areas from where pollution can travel to the groundwater source within 400 days or lies within the nearest 25% of the total catchment area (whichever is largest).
- The total catchment (Zone 3) indicates the total area needed to support removal/discharge of water from the groundwater source.
- A fourth zone is sometimes also defined when local conditions mean that pollution could affect the groundwater source even though it is outside the normal catchment area.

7.3.9. To ensure water quality of the supply source is maintained, there may be very restrictive restrictions on infiltration within these areas. In some cases, depending on the land uses proposed for the site, infiltration may not be permitted, particularly in SPZ1 which is the most sensitive area.

[16] Wokingham Borough Council (2010) Sustainable Design and Construction Supplementary Planning Document (SPD), available at: www.wokingham.gov.uk/EasySiteWeb/GatewayLink.aspx?alId=369287

[17] Wokingham Borough Council (2010-2011) Adopted Supplementary Planning Documents, available online at: http://www.wokingham.gov.uk/planning/planning-policy/supplementary-planning-guidance-and-documents/

7.4. FURTHER REFERENCES

7.4.1. More detail on SuDS can be found from the following sources:

- C753 The SuDS Manual (Woods Ballard B; Kellagher R et al, 2015 – available from the CIRIA bookshop www.ciria.org);
- Interim Code of Practice for Sustainable Drainage Systems, National SuDS Working Group, 2004 – available from CIRIA bookshop www.ciria.org.uk or Environment Agency website www.environment-agency.gov.uk;
- *Non-Statutory Technical Standards for Sustainable Drainage* (Defra, 2015 – Free download from: www.gov.uk)
- *Rainfall Runoff Management for Developments -Report – SC030219* (Kellagher R, 2013 – Free download from: www.gov.uk/government/organisations/environment-agency)
- C625 Model Agreements for Sustainable Water Management Systems, Shaffer et al, 2004, – available from CIRIA bookshop www.ciria.org.uk;
- C644 *Building greener. Guidance on the use of green roofs, green walls and complementary features on buildings* (Early P; Gedge D; Newton J; Wilson S, 2007- available from the CIRIA bookshop: www.ciria.org)
- C539 Rainwater and greywater use in buildings – best practice guide, Leggett et al, 2001, – available from CIRIA bookshop www.ciria.org.uk;
- C582 Source control using constructed pervious surface: hydraulic, structural and water quality performance issues, Pratt et al, 2002, – available from CIRIA bookshop www.ciria.org.uk;
- C635 Designing for exceedance in urban drainage – good practice, Digman et al, 2006, – available from CIRIA bookshop www.ciria.org.uk;
- Harvesting rainwater for domestic uses: an information guide, Environment Agency, 2010, - Free download from Environment Agency website www.environmentagency.gov.uk;
- W12 *Sustainable water management in schools* (Duggin & Reed, 2006 – Free download from: www.ciria.org)
- *National Planning Policy Framework (NPPF)* and PPG Flood Risk and Coastal Change (Department for Communities and Local Government, 2015 – Free download available from: http://planningguidance.planningportal.gov.uk)
- The Building Regulations: Approved document H – *Drainage and waste disposal* (Office of the Deputy Prime Minister, 2010 - Free download from: www.communities.com)
- www.ciria.org.uk/SuDS/
- BRE Digest 365 Soakway Design

8

ASSESSMENT OF POTENTIAL ALLOCATED SITES

8. ASSESSMENT OF POTENTIAL ALLOCATED SITES

8.1. THE LOCAL PLAN UPDATE - POTENTIAL ALLOCATED SITES

8.1.1. This SFRA includes an assessment of flood risk for each of the potential allocated sites in the Borough's Local Plan Update (LPU), which have been recommended for consideration. There are a total of 266 individual site assessments, some of which comprise logical clusters of sites, based on their geographical location. The LPU sites have been analysed in terms of flood risk to help with the Sequential Test and provide recommendations for the Exception Test where applicable.

8.1.2. No additional flood modelling work has been undertaken for this assessment. Existing modelling data has been used where available to support the SFRA. Updated hydraulic modelling is currently being progressed by Wokingham Borough Council, to support the provision of new distributor roads. However, at the time of writing it is anticipated that this modelling will to be approved by the Environment Agency until the spring of 2020. Indications from this modelling are that the overall floodplain definition for the Borough will not significantly change and local refinement of the watercourses is anticipated.

8.1.3. Once the modelling has been updated and approved by the Environment Agency, then a review of the impacts on the Sequential Testing of the LPU sites should be undertaken and if necessary, the Sequential Test updated. Summary comments and recommendations are necessarily brief but more detailed information has been provided in Chapters 6 and 7, which supports the recommendations included in the Appendix B tables.

8.1.4. For the fluvial flood zones, the proportion of the potential sites within each zone has been calculated, to give an indication of the likely area available for different types of land use. Note that the flood zones are mutually exclusive, so for example the area within Flood Zone 3a does not include the area within Flood Zone 3b. Note that none of the sites contain information on flood defences (which are a potential measure for passing the Exception Test). Consequently, the consideration of defences and the potential benefit provided must be reviewed. Flood hazard mapping is not available for all the main rivers in the Borough. Where flood hazard is not shown, a site-specific FRA should confirm the level of flood hazard.

Recommendations

8.1.5. In accordance with the Sequential Test, it is recommended that in identifying sites for allocation, sites that are entirely in Flood Zone 1 should be the first preference.

8.1.6. Once these have been identified and if further sites are required, sites with a greater flood risk may be considered. The aim should be to always minimise flood risk to the development by first seeking sites that are in, or partially in, Flood Zone 2, then 3a, and finally 3b.

8.1.7. The Sequential Test should also take all possible sources of flood risk into account. The percentage of each site at risk of surface water flooding has been calculated based on the Flood Map for Surface Water (FRMfSW). Surface water flood risk should be used as part of the Sequential Test to rank sites that have the same fluvial flood risk (i.e. two sites wholly located in Flood Zone 1 can be ranked based on the percentage of the site in each of the surface water flood risk extents). Areas susceptible to groundwater flooding have also been reviewed and considered as part of the Sequential Test.

8.1.8. The Sequential Test (refer to Appendix B) identifies potential appropriate use classes and have been graded using a Red, Amber, Green system, where:

- Red; Not an appropriate use;
- Amber; Not appropriate, but may be justifiable by application of the Exception Test; and,
- Green; An appropriate use.

8.1.9. The Sequential Test included in Appendix B has been undertaken using a methodology described in WSP's Sequential Test Methodology – Method Statement (August 2019). The Method Statement was issued to the Environment Agency who confirmed it to be acceptable in September 2019. Appendix B also includes an addendum to the Method Statement highlighting several minor adjustments to the Sequential Test Approach to address data limitations and more recent data however the general approach remains as set out in the Sequential Test Methodology.

8.1.10. Appendix C provides a summary of the Flood Risk considerations for each site and the key themes for LPU sites occurring within the Flood Zone classifications are summarised on the following pages, along with a short list of the sites within each classification.

8.1.11. For the purpose of this SFRA the submitted LPU sites have been grouped into 176 logical clusters based on their geographical location. This does not preclude the Council considering the sites individually and the classification of each cluster in the following sections does not mean every individual site in that cluster has the same classification.

8.1.12. A summary of the LPU Sites and their Flood Zone classification are provided in the following sections. The classification is based on the highest risk Flood Zone present within each cluster and does not necessarily mean the whole site area falls under this classification. For example, where 5% of the area of a particular cluster is identified as being within Flood Zone 3B, the site has been given a FZ3B classification regardless of whether the remaining 95% could potentially be developed appropriately.

8.2. FLOOD ZONE 1 LPU SITES

8.2.1. The following sites are located within Flood Zone 1, and are therefore the most appropriate development sites as defined by the Sequential Test. These sites should be developed in preference to the other LPU sites. There are 211 LPU sites within Flood Zone 1, with a combined Site area of around 1671 hectares.

Table 13 - Flood Zone 1 LPU Sites

LPU Reference								
5AR001	5BA024	5FI018	5HU005	5RU006	5SH024	5SW008	5WI007	5WK037
5AR002	5BA025	5FI019	5HU006	5RU007	5SH027	5SW009	5WI011	5WK038
5AR003	5BA027	5FI021	5HU008	5RU008	5SH030	5SW010	5WI012	5WK039
5AR004	5BA029	5FI022	5HU015	5S0008	5SH031	5SW011	5WI013	5WK040
5AR005	5CV002	5FI023	5HU016	5SH001	5SH032	5SW013	5WI014	5WO002
5AR006	5CV004	5FI024	5HU018	5SH002	5SH033	5SW015	5WI017	5WW001
5AR011	5CV005	5FI025	5HU019	5SH003	5SH035	5SW017	5WK008	5WW002
5AR013	5EA001	5FI026	5HU024	5SH005	5SH042	5SW018	5WK011	5WW004
5AR014	5EA002	5FI027	5HU025	5SH006	5SH043	5SW019	5WK012	5WW005
5AR016	5FI001	5FI028	5HU026	5SH007	5SH044	5SW020	5WK015	5WW010
5AR020	5FI002	5FI029	5HU027	5SH008	5SH045	5SW021	5WK017	5WW011
5AR023	5FI003	5FI030	5HU028	5SH009	5SH046	5TW008	5WK018	5WW012
5AR024	5FI004	5FI031	5HU029	5SH010	5SH051	5WA002	5WK019	5WW014
5BA002	5FI005	5FI032	5HU031	5SH011	5SH053	5WA003	5WK021	5WW015
5BA003	5FI007	5FI040	5HU034	5SH012	5SO001	5WA004	5WK022	5WW016
5BA004	5FI008	5FI041	5HU040	5SH013	5SO002	5WA005	5WK023	5WW017
5BA006	5FI009	5FI042	5HU042	5SH014	5SO003	5WA006	5WK025	5WW018
5BA009	5FI010	5FI045	5HU046	5SH015	5SO004	5WA007	5WK026	5WW020
5BA011	5FI012	5FI046	5HU049	5SH016	5SO005	5WA008	5WK028	5WW022
5BA012	5FI013	5FI047	5HU050	5SH017	5SO007	5WA009	5WK029	
5BA013	5FI014	5FI048	5RU001	5SH018	5SO009	5WA010	5WK032	
5BA017	5FI015	5HU001	5RU002	5SH019	5SW002	5WI001	5WK033	
5BA018	5FI016	5HU002	5RU003	5SH020	5SW003	5WI002	5WK034	
5BA019	5FI017	5HU004	5RU005	5SH022	5SW007	5WI003	5WK035	

8.2.2. Development within Flood Zone 1 should consider the following:

- The potential for a change in the Flood Zone classification at the site because of climate change, over the lifetime of the development.
- The risk of surface water flooding on-site attributable to runoff from off the site and how this is managed within the development layout.
- The use of SuDS to reduce where practicable, the rate and volume of surface water runoff generated by the site to the greenfield rate.
- The potential impacts of groundwater flooding on the development and the potential for the development to impact on groundwater flows.
- The proximity of the site to any Main Rivers or Ordinary Watercourses. Usually any development within 20m of a water feature will require some form of Statutory Consent.

8.3. FLOOD ZONE 2 LPU SITES

8.3.1. The following sites are located within Flood Zone 2 and should only be developed should the Flood Zone 1 sites be unable to deliver the development requirements for Wokingham Borough Council. There are 13 LPU sites within Flood Zone 2, with a combined area of around 63 hectares.

Table 14 - Flood Zone 2 LPU Sites

LPU Reference				
5BA008	5HU035	5SH023	5TW005	5WK030
5FI039	5HU044	5SH026	5TW009	
5HU032	5HU048	5SW006	5WI010	

8.3.2. Development of sites within Flood Zone 2 should consider the following:

- The potential for a change in the Flood Zone classification at the site as a result of climate change, over the lifetime of the development.
- The risk of surface water flooding on-site attributable to runoff from off the site and how this is managed within the development layout.
- The use of SuDS to reduce, where practicable, the rate and volume of surface water run-off generated by the site to the Greenfield rate.
- The potential impacts of groundwater flooding on the development, and the potential for the development to impact on groundwater flows.
- The proximity of the site to any Main Rivers or Ordinary Watercourses. Usually any development within 20m of a water feature will require some form of Statutory Consent.
- Requirements for floodplain compensation. As a minimum a 10% increase for any floodplain compensation scheme for the 1% AEP plus climate change scenario should be considered.
- Safe access and egress from the site (i.e. is the site located in a “dry island”?). Will safe emergency access to and from the site be available throughout the actual flood event?
- All habitable accommodation, and uses sensitive to flooding, should be set at least 300mm above the 1 in 100 plus climate change flood level.

8.4. FLOOD ZONE 3A LPU SITES

8.4.1. The following sites are located within Flood Zone 3A and should only be developed should the Flood Zone 1 and 2 sites be unable to deliver the development requirements for Wokingham Borough Council. There are 18 LPU sites within Flood Zone 3A, with a combined site area of around 277 hectares.

Table 15 - Flood Zone 3A LPU Sites

LPU Reference					
5CV001	5SH049	5SW004	5SW016	5WI008	5WW003
5HU030	5SH052	5SW005	5TW007	5WI015	5WW009
5RU004	5SW001	5SW012	5TW011	5WK036	5WW013

8.4.2. Development of sites within Flood Zone 3A should consider the following:

- The potential for a change in the Flood Zone classification at the site because of climate change, over the lifetime of the development.
- The risk of surface water flooding on-site attributable to runoff from off the site and how this is managed within the development layout;
- The use of SuDS to reduce where practicable, the rate and volume of surface water runoff generated by the site to the greenfield rate.
- The potential impacts of groundwater flooding on the development and the potential for the development to impact on groundwater.
- The proximity of the site to any Main Rivers or Ordinary Watercourses. Usually any development within 20m of a water feature will require some form of Statutory Consent.
- Requirements for floodplain compensation. As a minimum a 10% increase for any floodplain compensation scheme for the 1% AEP plus climate change scenario should be considered.
- Safe access and egress from the site (i.e. is the Site located in a “dry island”?). Will safe emergency access to and from the site be available throughout the actual flood event?
- Buildings used for dwelling houses and other uses sensitive to flooding, should be set at least 300mm above the 1% AEP plus climate change flood level.
- During exceedance flood events, how all people on the site will be safe throughout the duration of the flood event.
- How the proposals would satisfy the requirements of the Exception Test, if this is necessary.

8.5. FLOOD ZONE 3B LPU SITES

8.5.1. The following sites are located within Flood Zone 3B and should only be developed for the specific development types outlined in the NPPF. Flood Zone 3B is classified as the functional floodplain and therefore, has the greatest risk of flooding. There are 24 LPU sites within Flood Zone 3B, with a combined site area of around 957 hectares.

Table 16 - Flood Zone 3B LPU Sites

LPU Reference					
5AR015	5HU003	5SH021	5TW010	5WI009	5WK013
5BA010	5HU007	5SH025	5WI004	5WK002	5WW006
5BA016	5HU037	5SH040	5WI005	5WK006	5WW019
5BA026	5HU043	5TW006	5WI006	5WK009	5WW023

8.5.2. The majority of the LPU sites identified as being within Flood Zone 3B have less than 10% of their potential development area within the Flood Zone 3B. Therefore, there is the potential for the residual of the site to be developed, outside of the flood risk area. However, in terms of Planning Policy, the Environment Agency are likely to recommend an objection to any planning application for a site including areas of development in a Flood Zone 3B. It is therefore strongly recommended that pre-application consultation with the Environment Agency and Wokingham Borough Council is undertaken, to determine the appropriate steps for these sites to be considered for development.

8.5.3. Flood Zone 3B forms the basis of land that should be safeguarded for flood protection. This should be considered only for development that is compatible with flooding and provides a meaningful contribution to flood protection. The area considered for safeguarding is provided in Appendix A.11.

8.5.4. Development of sites within Flood Zone 3B should consider the following:

- The potential for a change in the Flood Zone classification at the site because of climate change, over the lifetime of the development.
- The risk of surface water flooding on-site attributable to runoff from off the site and how this is managed within the development layout.
- The use of SuDS to reduce where practicable, the rate and volume of surface water runoff generated by the site to the greenfield rate.
- The potential impacts of groundwater flooding on the development, and the potential for the development to impact on groundwater flows.
- The proximity of the site to any Main Rivers or Ordinary Watercourses. Usually any development within 20m of a water feature will require some form of Statutory Consent.

- Requirements for floodplain compensation. As a minimum a 10% increase for any floodplain compensation scheme for the 1% AEP plus climate change scenario should be considered.
- Safe access and egress from the site (i.e. is the Site located in a “dry island”?). Will safe emergency access to and from the site be available throughout the actual flood event?
- Buildings used for dwelling houses and other uses sensitive to flooding, should be set at least 300mm above the 1% AEP plus climate change flood level.
- During exceedance flood events, how all people on the site will be safe throughout the duration of the flood event.
- How the proposals would satisfy the requirements of the Exception Test, if this is necessary.
- Development within Flood Zone 3B will usually trigger an Environment Agency planning objection, which they are likely to maintain at an appeal. It is therefore, essential that the Environment Agency are consulted as part of the development of the proposals at the site.
- Sites classified as being within the Functional Floodplain should not be considered as being appropriate for development.

9

CONCLUSIONS AND RECOMMENDATIONS

9. CONCLUSIONS AND RECOMMENDATIONS

9.1. FLUVIAL FLOODING

9.1.1. The data available for SFRA's is continually changing and being improved. Since the previous SFRA for Wokingham Borough, the key information that has become available are the updated flood zones based on recent modelling of the River Blackwater and River Loddon. The currently published modelling includes the simulation of the 0.1% AEP fluvial event, which is used to define the extents of Flood Zone 2. The previous Flood Zone 2 extents were determined by the National Flood Risk Assessment mapping, which used a high-level extent that does not always include local ground variations. The current Flood Zone 2 extents provides a much-improved definition of the floodplain.

9.1.2. Based on the mapping currently available, Wokingham Borough is at risk of flooding from rivers in a number of locations. Analysis of historical data shows that these rivers have flooded in the past along much of their length, often at several occurrences. Both the flood zones and historical flooding show that property is at risk in several locations, but for the most part the preservation of the river corridor with lakes and meadows has provided space for the river to flood. It will be very important in the future to ensure this strategy is maintained or improved where possible.

Fluvial Flooding: Recommendations

Sequential Approach

The SFRA flood maps (Appendix A) and LPU sites assessment data sheets (Appendix C) should be referred to when applying the Sequential Test for allocating development. The sequential test should also be applied to windfall sites at the planning application stage. The sequential approach should also be followed within sites that contain more than one flood zone. Refer to section 3.5 for guidance on the Sequential Test.

The Exception Test is appropriate where the Sequential Test is not able to deliver sufficient suitable sites and also where some continuing development is necessary for wider sustainable development reasons. Refer to section 3.6 for guidance on the Exception Test.

Flood Risk Assessments

Site specific FRA's must demonstrate how flood risk will be managed within the site, without increasing flood risk to the surrounding area or to the site itself. The Council will make their decision based on evidence within the FRA, as to whether the development is acceptable on flood risk grounds. The Environment Agency is a statutory consultee regarding flood risk and will provide guidance and assistance to the Council. Developers are recommended to have regard to the Environment Agency's standing advice for FRAs. Chapter 6 provides guidance on FRA's and recommends the criteria to assess in the FRA. Chapter 5 provides an overview of flood risk by character area.

Flood Zones

Further updates to the flood zones are likely to occur, as further updated studies are undertaken on river catchments. Once the Environment Agency approves these studies the new flood outlines will be incorporated into their flood zone maps. SFRAs are living documents and should be regularly updated to take account of the latest flood zones. Any documents reliant on the findings of the SFRA or flood mapping should also be reviewed. Refer to section 3.2 for guidance on the Flood Zones.

Climate Change

Climate change must be considered. One way to increase the sustainability of development is by seeking to avoid not just the present-day Flood Zone 3a, but also the climate change 1 in 100 year return period flood extents. Where this is not practicable then site and building design should be used to mitigate risk based on the 1 in 100 year return period plus climate change flood level, such as raising of floor levels and ensuring safe access. Refer to section 4.3.20 for guidance on the effects of climate change.

Flood Hazard

Developers must consider flood hazard, both within the site itself and regarding any routes used to access the site. Safe access must be ensured for both pedestrians and vehicles, taking due regard of the vulnerability of the site users. Refer to section 3.3 for guidance on flood hazard.

Flood Storage

In the case of schemes such as flood storage or land management restrictions, since this land has been specifically designated to aid flood management, it should be considered as a spatial constraint to development proposals. Structures, such as weirs, may also pose a constraint to future development since access will need to be maintained. Refer to Section 6 for guidance on current flood risk management including flood defences, flood storage and structures.

Residual Risk

In the majority of instances flood risk can be managed but never completely removed. Residual risks are those which remain after following the sequential approach and require action to control risk (see section 3.4). Measures to mitigate residual risk should be applied where appropriate including:

- Raising the ground floor levels of buildings above the 1 in 100 year return period plus climate change level, including an appropriate freeboard level.
- Flood resistant, resilient and repairable building design.
- Safe access, ideally above the 1 in 100 year return period plus climate change level. If this is not possible then signposted routes through limited depths of flooding may be acceptable, depending on the flood water depth/velocity and risk of debris and the vulnerability of people on site.
- Effective flood warning and emergency planning.

Community Resilience (Emergency Planning) – Vulnerable Sites

Within Wokingham Borough, relatively few of the vulnerable sites (schools, hospitals etc.) are located within high risk flood risk areas. There are some located within Flood Zone 2, which is acceptable for all the vulnerability classifications in these instances (more vulnerable, less vulnerable and essential infrastructure). However, it is recommended that emergency plans should be put in place for the event of an extreme flood.

To enable consideration of Flood Zone 3a with climate change, it is recommended that adequate measures should be put in place before climate change impacts result in unacceptable levels of flood risk to essential community facilities. This should be either through pro-active design to include the ability to provide adaptive response, or a climate change resistant design. Alternatively, if feasible (particularly if the building comes to the end of its lifetime), it would be beneficial to relocate to a site outside of Flood Zone 3a. Refer to section 4.5 for further guidance on Community Resilience.

9.2. SURFACE WATER FLOODING

9.2.1. A significant increase of information has occurred for surface water flood risk, with the release of the Environment Agency surface water flood maps.

9.2.2. Comparison with historical records from 1993 and 2007 show similarity between the surface water flooding locations, or areas where surface runoff appears to have overwhelmed the sewerage system, within the scale limits of the surface water mapping.

9.2.3. The surface water mapping arises from The Pitt Review (2007), which is one of the key policy releases since the previous SFRA. This, in combination with the Flood and Water Management Act 2010, has raised the profile of flooding from sources other than fluvial.

9.2.4. Under the Flood and Water Management Act, Wokingham Borough Council as the LLFA, has responsibility for managing flooding from surface runoff, groundwater, and ordinary watercourses (including lakes and ponds), in their administrative area. This includes developing a strategy for dealing with flood risk, working in partnership with other flood management authorities to coordinate functions, maintaining registers of and protecting structures and features (which provide significant flood control) and in some cases carrying out works to manage flood risk.

9.2.5. In addition, the Council will act as a SuDS Approving Body with responsibility for approving drainage proposals for new developments and for adopting and maintaining SuDS which serve more than one property, apart from those on public roads which are the responsibility of Highways authorities[18]. In addition to the SFRA, the Council also has obligations to produce flood risk reports and mapping for flooding from other sources under the Flood Risk Regulations for the EC Floods Directive.

[18] The Council is responsible for maintaining all the roads in the Borough, except for the M4, which is the responsibility of the Highways Agency

Surface Water Flooding: Recommendations

Developers are required to manage surface water flood risk to ensure it is not worsened for their site or the surrounding area and ideally, that betterment of existing conditions is achieved to as near greenfield as possible (see Chapter 6). SuDS should be used wherever possible.

For sites in Flood Zones 2, 3a and 3b, and sites in Flood Zone 1 of more than 1ha, surface water management should be considered in the site-specific FRA. For Flood Zone 1 sites of less than 1ha, a Surface Water Drainage Strategy should be produced following the same principles. This is in line with Sustainability Issue 5 (Flood Risk Management) of the adopted Sustainable Design and Construction SPD.

Surface Water Modelling

The Flood Map for Surface Water (FMfSW) is recommended for assessment of surface water flooding, but it should be reviewed in the context of local land form and drainage capacity, when considering a site-specific FRA.

Some of the modelling parameters may not be appropriate at the local scale, or there may be features which affect the flow path that the modelling scale used could not take account of. Therefore, the map should be taken as indicative so where local knowledge exists that indicates flooding may differ from the FMfSW. It is important that this is taken into account, in some cases, replacing the FMfSW. This is the case for the Swallowfield, Riseley and Farley Hill area, for which FRAs must take account of historical incidents and flow paths.

The FMfSW provides an indication of the flow paths for surface runoff and potential ponding areas, based on the ground topography and taking buildings into account. However, FRAs should take account of the volume and peak rate of runoff using the methodology from R&D Technical Report W5-074/A/TR1 Preliminary rainfall runoff management for developments (Defra/Environment Agency, Revision D published September 2005) and ensure the development does not increase this either on site or to the surrounding area.

Should further information on surface water runoff be required, this may be possible through detailed local surface water modelling. The main benefits of this compared to the FMfSW are the potential to consider additional factors such as soil permeability, level of urbanisation, or more locally appropriate allowance factors for the sewer system and produce outputs including velocity and hazard as well as depth.

Sustainable Drainage Systems (SuDS)

Developers should consider SuDS as their first choice for managing surface water and should design carefully following the SuDS management train. There must be clear and whole-life arrangements in place for their continuing SuDS maintenance. Refer to Chapter 7 for guidance on SuDS. The Wokingham Borough Sustainable Design and Construction SPD, at paragraphs 12.9 to 12.13 of Chapter 12 (Flood Risk Management), provides further information on SuDS. To ensure SuDS are integrated holistically into a development, paragraph 12.12 of the SPD lists the stages that need to occur before development commences.

SWMPs are carried out where Councils need to ascertain a more detailed picture of surface water flooding issues in an area and develop strategies for managing it. At present (apart from the Greater Reading SWMP – a joint project between Reading Borough Council and Wokingham Borough Council), Wokingham Borough Council does not have plans to carry out further SWMP's. However, should this change in the future, based on the analysis of the surface water mapping and historical areas, the locations where a SWMP is most likely to be useful are as follows:

- Wokingham.
- Winnersh.
- The outskirts of Reading near the A329.
- Spencers Wood.
- The Swallowfield – Riseley – Farley Hill area.

Pinewood may also benefit from a SWMP but if so, it is recommended that this be carried out for the whole of the town of Crowthorne in partnership with the neighbouring Borough of Bracknell Forest.

9.3. GROUNDWATER FLOODING

9.3.1. Data on groundwater flood risk remains limited, with historical data typically sparse and no modelling available. Therefore, an analysis of possible risk has been made based on geological information from the Environment Agency aquifer maps and British Geological Survey maps. This indicates that parts of the Borough are at risk due to the presence of underlying primary or secondary aquifers. The greatest risk is likely to be from the highly permeable Chalk in the north of the Borough or from the Sand and Gravel superficial deposits scattered across the Borough. High groundwater levels are most likely to be a problem for substructure construction, basements and for infiltration SuDS. Refer to section 6.3.5 for guidance on groundwater flood risk.

Groundwater Flooding: Recommendations

It is recommended that infiltration SuDS are not used in areas of high groundwater levels.

Based on information available for this SFRA, high groundwater levels are most likely along the river valleys. As a 'highly vulnerable' land use basements are not permitted in Flood Zones 3a or 3b and are required to pass the Exception Test in Flood Zone 2. Basements are therefore, already precluded from many of the areas at groundwater risk. Given the frequency of historical flooding along the rivers in Wokingham Borough, which often reaches Flood Zone 2 extents, it is recommended that basements are also excluded from Flood Zone 2.

Suitability for infiltration SuDS and for basements outside of Flood Zones 2, 3a and 3b, will be more dependent on assessment in site-specific FRAs. Where possible, it is recommended that site investigation of soil type and groundwater levels is carried out using trial pits or bore holes. It should also be borne in mind that where permeable geology is capped by a low permeability superficial deposit, there is a risk that development work could breach the covering layer and thus provide a path for groundwater to reach the surface. Where site investigation is not possible, groundwater flood risk may be estimated based on geological and topographical information, with groundwater flood risk most likely in low-lying permeable ground.

9.4. LPU SITES ASSESSMENT

9.4.1. An assessment of flood risk to the sites submitted for consideration in the LPU (this excludes sites within the SDL's) has been made. This information will assist the Council in carrying out the Sequential Test. Also included is an overview indication of their likely SuDS potential. The assessments can be found in Appendix C.

Allocating Sites in the LPU: Recommendations

The SFRA flood maps should be used to allocate development in accordance with the Sequential Test. Most of the Borough is located within Flood Zone 1, so it is likely that the Borough Council can fulfil the majority of its development requirements at the lowest degree of fluvial flood risk. Over 75% of the LPU sites are entirely within Flood Zone 1 and these should be considered first for allocation.

Should there be an insufficient number of sites in Flood Zone 1 for the Council's requirements, then sites in or partially in, Flood Zone 2 (then 3a, then 3b) may be required, considering the vulnerability classification of the proposed development (refer to Table 5 and Table 6).

When a planning application is submitted on an allocated site, flood risk issues should be assessed in more detail following the guidance on FRAs and SuDS in Chapters 6 and 7 and the Environment Agency's advice for FRAs at http://www.environmentagency.gov.uk/research/planning/93498.aspx. Developers should propose land uses which are compatible with the sites flood zones, based on the vulnerability classifications in Table 5 and Table 6.

If the development site currently has existing buildings which are not compatible with the flood zone, it is recommended that redevelopment be used as an opportunity to substitute a more compatible use. For example, if a flood zone 3a site currently contains residential housing, it is recommended that these should not be replaced on the site if a more suitable location can be found elsewhere in a lower risk flood zone. Only if there is no suitable alternative should replacement dwellings be built on site, subject to passing the Exception Test. Residential development should not be permitted in Flood Zone 3b (only water compatible or essential infrastructure should be considered).

GLOSSARY

Annual Monitoring Report (AMR) - Assesses the implementation of the Local Development Scheme and the extent to which policies in Local Development Documents are being successfully implemented.

Aquifers - Underground layers of water-bearing permeable rock or drift deposits from which groundwater can be extracted. The Environment Agency categorise these into principal aquifers, which provide a high level of water storage on a strategic scale, and secondary aquifers which provide water on a more limited, local scale.

Biodiversity Action Plans (BAPs) – The UK initiative, in response to the Rio Summit in 1992, to conserve and enhance biodiversity. The plan combines new and existing conservation initiatives with the emphasis on a partnership approach and seeks to promote public awareness.

Catchment Flood Management Plan (CFMP) – A strategic planning tool through which the Environment Agency seeks to work with other key decision-makers within a river catchment, to identify and agree policies for sustainable flood risk management.

Ciria - Construction Industry Research and Information Association

Core Strategy - The Development Plan Document which sets the long-term spatial planning vision and objectives for the area. It contains a set of strategic policies that are required to deliver the vision including the broad approach to development.

Development Plan Documents (DPDs) - Spatial planning documents within the Council's Local Development Framework which set out policies for development and the use of land. They are subject to independent examination. They are required to include a core strategy and a site allocations document, and may include area action plans if required; other DPDs may also be included, e.g. development control policies.

DEFRA - Department for Environment, Food & Rural Affairs.

Emergency Planning / Community Resilience – Planning for and response to emergencies such as flooding, including consideration of the resilience of emergency infrastructure that will need to operate during flooding.

Environment Agency - The leading public body for protecting and improving the environment in England and Wales. Flood management and defence are a statutory responsibility of the Environment Agency; it is consulted by local planning authorities on applications for development in flood risk areas, and also provides advice and support to those proposing developments and undertaking Flood Risk Assessments. The Environment Agency reports to DEFRA.

Environment Agency Flood Zones - In 2001 PPG25 (the predecessor of PPS25) imposed a duty on the Environment Agency to produce maps showing the predicted extent of tidal and fluvial flood zones for all Main Rivers in England and Wales. The updates are carried out on a quarterly basis and the latest versions of the Environment Agency flood zones are published on their website at www.environment-agency.gov.uk. The flood zones are based on current environmental conditions, so do not make any allowance for climate change (however, where detailed modelling has been carried out, climate change scenarios are usually addressed for at least the 100 year and these results can be obtained from the Environment Agency on request).

Flood Estimation Handbook - The latest hydrological approach for the estimate of flood flows in UK. Published by the Centre for Ecology and Hydrology (CEH) to provide methodology for estimating fluvial flood flows. The handbook (which comprises 5 volumes) is accompanied by a CD-ROM which contains a digital map of the country. Users can select river catchments from the CD-ROM digital map, and obtain a set of catchment descriptors describing features of the catchment relevant to estimating fluvial flood flows.

Flood Risk Assessment (FRA) – A site specific investigation carried out by site developers to be submitted as part of their planning applications. It assesses both current flood risk to the site and ensures development does not increase flood risk to the site or surrounding areas.

Flood Risk Vulnerability - PPS25 provides a vulnerability classification to assess which uses of land may be appropriate in each flood risk zone.

Formal Flood Defence - A structure built and maintained specifically for flood defence purposes. Freeboard - the difference between the flood defence level and the design flood level, used to allow for dynamic wave height as well as an extra margin of safety, for example due to uncertainty in the flood level estimation.

Greenfield Runoff - The surface water runoff regime from a site before development. This is normally taken to mean the site in its natural state (i.e. no man-made developments on site), but sometimes it is taken to mean the existing site conditions for brownfield redevelopment sites.

Groundwater Source Protection Zones – Are defined for groundwater sources such as wells, boreholes and springs used for public drinking water supply to show the risk of contamination from any activities that might cause pollution in the area. Three main zones are defined; the inner protection zone (Zone 1) indicates areas from where pollution can travel to the groundwater source within 50 days or is at least a 50m radius, the outer protection zone (Zone 2) indicates areas from where pollution can travel to the groundwater source within 400 days or lies within the nearest 25% of the total catchment area (whichever is largest), and the total catchment (Zone 3) indicates the total area needed to support removal/discharge of water from the groundwater source. A fourth zone is sometimes also defined when local conditions mean that pollution could affect the groundwater source even though it is outside the normal catchment area.

Habitable Room - A room used as living accommodation within a dwelling but excludes bathrooms, toilets, halls, landings or rooms that are only capable of being used for storage. All other rooms, such as kitchens, living rooms, bedrooms, utility rooms and studies are counted.

Hydrology of Soil Types (HOST) from the Flood Estimation Handbook (FEH) published by the Centre for Ecology and Hydrology (CEH) - This classifies soils according to their hydrological properties of Standard Percentage Runoff (SPR) and Base Flow Index (BFI).

Informal Flood Defence - A structure that provides a flood defence function, but has not been built or maintained for this specific purpose (e.g. a boundary wall).

JFlow - A computer river model based on routing a flood calculated by Flood Estimation Handbook methodology along a river corridor, the levels of which are derived from a Side Aperture Radar (SAR) remote sensed Digital Terrain Model.

LiDAR – 'Light Detection and Ranging' is an airborne terrain mapping technique which uses a laser to measure the distance between the aircraft and the ground. It therefore provides accurate topographical/contour mapping.

Local Development Documents (LDD's) – the collective term for Development Plan Documents and Supplementary Planning Documents.

Local Development Framework (LDF) - The name for the portfolio of Local Development Documents. It consists of the Local Development Scheme, a Statement of Community Involvement, Development Plan Documents, Supplementary Planning Documents, and the Annual Monitoring Report.

Local Development Scheme (LDS) - Sets out the programme for preparing Local Development Documents. All authorities must submit a Scheme to the Secretary of State for approval within six months of commencement of the 2004 Act (thus all authorities should now have submitted an LDS). LDSs are subject to review.

Local Planning Authority (PLA) - is the local authority or council that is empowered by law to exercise statutory town planning functions for a particular area of the United Kingdom.

Local Plan Update (LPU) - This updated local plan will guide development in the Borough for the next 20 years.

Main Rivers – Principal rivers or locally significant watercourses as defined by Section 93 of the Water Resources Act, 1991 and shown on a formal map held by the Environment Agency.

Ministry of Housing, Communities and Local Government (MHCLG) – Government Department, formally the Department for Communities and Local Government. The Department sets policy on supporting local government; communities and neighbourhoods; regeneration; housing; planning, building and the environment; and resilience to fire and other emergencies including flooding.

Mitigation - where flood risk cannot be avoided or controlled, mitigation measures should be applied to further reduce the risk of flooding and/or minimise the danger and damage caused by flooding to acceptable levels. This could include options such as non-habitable ground floors, resistant and resilient design, flood warning and evacuation plans.

National Flood Risk Assessment (NaFRA) - Flood risk assessment that uses a risk-based approach to factor in the location, type, condition and effects of flood defences. It calculates the actual likelihood of flooding to areas of land within the floodplain of an extreme flood (0.1% or 1 in 1000 chance in any year), considering the distance from the river or the sea, and factors in the probability that the flood defences will overtop or breach. A variety of scenarios are analysed in order to determine properties at low, moderate and significant flood risk. Ordinary Watercourses – Watercourses not designated as main rivers. Generally also include lakes and ponds (excluding those designated as reservoirs).

National Planning Policy Framework **(NPPF)**- The National Planning Policy Framework sets out the Government's planning policies for England and how these are expected to be applied. It sets out the Government's requirements for the planning system only to the extent that it is relevant, proportionate and necessary to do so. It provides a framework within which local people and their accountable councils can produce their own distinctive local and neighbourhood plans, which reflect the needs and priorities of their communities.

Planning Policy Statements - The Government has updated its planning advice contained within Planning Policy Guidance Notes (PPGs) with the publication of new style Planning Policy Statements (PPSs), which set out its policy for a range of topics.

Preliminary rainfall runoff management for developments - Research and Development Technical Report W5- 074/A/TR1 Revision D, September 2005, published by the Environment Agency and Defra. This contains guidance on how developments are required to manage surface runoff so as to avoid increasing flood risk on site or elsewhere. A simplified methodology is provided for calculating greenfield runoff rates and estimating the approximate volumes required for attenuation, long term and treatment storage in order to ensure that the redeveloped site maintains the greenfield characteristics.

Previously Developed (Brownfield) Land - Land which is or was occupied by a building (excluding those used for agriculture and forestry). It also includes land within the curtilage of the building, for example a house and its garden would be considered to be previously developed land. Land used for mineral working and not subject to restoration proposals can also be regarded as brownfield land. Residual Risk - The risk which remains after all risk avoidance, reduction and mitigation measures have been implemented.

Return Period – Return Period is a statistical measure of how often, on average, an event could occur. It is the inverse of Annual Exceedance Probability (AEP), where AEP is the probability of a storm event of given magnitude or greater occurring in any given year. It should be noted that both return period and AEP are probability measures, so for example an event which has a 5 year return period (or 20% AEP) has a 1 in 5 chance of occurring in any given year, and is expected to occur once every 5 years on average. The on average term is important - just because it has happened one year does not mean it will not occur again for the next 4 years; there is still a 1 in 5 chance each year of the storm, or a larger storm, occurring, but over a long period of time it is expected that a fifth of the years will have had a storm of that magnitude or larger.

River Basin Management Plan (RBMP) – A strategic tool introduced by the Water Framework Directive (2000/60/EC) which integrates the management of land and water within a river basin (river catchment or group of catchments). The river basin may cover several political areas.

Sewers for Adoption (SFA) - The 6th edition of "Sewers for Adoption" was published by WRC PLC in March 2006 ready for implementation by all Water Companies on 1st May 2006. SFA 6 includes detailed requirements for lateral drains and SuDS in order that they can be offered for adoption.

Standard Percentage Runoff (SPR) - An indication of the proportion of rainfall which is likely to contribute to surface runoff, after some of the rainfall has infiltrated into the soil Source Protection Zones (SPZ): These are defined for groundwater resources such as wells, boreholes and springs used for public drinking water supply. The zones show the risk of contamination from any activities that might cause pollution in the area. The closer the activity, the greater the risk. The maps show three main zones, inner (SPZ1), outer (SPZ2) and total catchment (SPZ3), and occasionally a fourth zone of special interest (SPZ4) is applied in karstic areas where surface runoff from beyond the groundwater catchment can enter through features such as swallow holes.

Strategic Environmental Assessment (SEA) - A generic term used to describe environmental assessment as applied to policies, plans and programmes. The European ‘SEA Directive’ (2001/42/EC) requires a formal ‘environmental assessment of certain plans and programmes, including those in the field of planning and land use’.

Strategic Flood Risk Assessment (SFRA) – A Level 1 SFRA is a living document which is used as a tool by a planning authority to assess flood risk for spatial planning, producing development briefs, setting constraints, informing sustainability appraisals, identifying locations of emergency planning measures and requirements for flood risk assessments. This report provides information on flood risk within the Borough and guidance on application of the Sequential Test and Flood Risk Assessments for development planning. A Level 2 SFRA is a more detailed assessment produced where the Exception Test is required for a potential development site.

Strategic Flood Risk Management – managing flood risk strategically, for example cross-border cooperation of authorities in the same river catchment, or on adjacent sections of shoreline, seeks to manage flood risk in a way that achieves the optimum results throughout the catchment/shoreline. This ensures that flood defence measures at one location do not worsen flood risk at another, or if flood risk must be worsened somewhere, that it is in an appropriate location.

Supplementary Planning Documents (SPDs) - Provide supplementary information in respect of the policies in Development Plan Documents. They do not form part of the Development Plan and are not subject to independent statutory examination, but are normally subject to public consultation.

Sustainability Appraisal (SA) - Tool for appraising policies to ensure they reflect sustainable development objectives (i.e. social, environmental and economic factors) and required in the 2004 Act to be undertaken for all local development documents. It incorporates Strategic Environmental Assessment.

Sustainable Development – "Development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Resolution 42/187 of the United Nations General Assembly)).

Sustainable Drainage Systems (SuDS) – Surface water drainage systems which manage runoff in a more sustainable way than conventional drainage, through improved methods of managing flow rates, protecting or enhancing water quality and encouraging groundwater recharge. A variety of types are available and can be chosen as appropriate for the location and needs of the development, and many have added benefits such as enhancement of the environmental setting, provision of habitat for wildlife and amenity value for the community.

The Exception Test - If, following application of the Sequential Test, it is not possible (consistent with wider sustainability objectives) to demonstrate that there are no reasonably available sites in areas with less risk of flooding that would be appropriate to the type of development or land use proposed, the Exception Test may apply. PPS25 sets out strict requirements for the application of the Test.

The Sequential Test - Informed by a Strategic Flood Risk Assessment, a planning authority applies the Sequential Test to demonstrate that there are no reasonably available sites in areas with less risk of flooding that would be appropriate to the type of development or land use proposed.

Windfall Sites – Windfall sites are those which have not been specifically identified as available in the development plan.