

AMBI³ENTAL

ENVIRONMENTAL ASSESSMENT

Flood Risk Assessment 6510

4 Sandhills Meadow,
Shepperton,
TW17 9HY

Document Issue Record

Project: Phase 1 Flood Risk Assessment

Prepared for: Mr & Mrs Lees

Reference: 6510

Site Location: 4 Sandhills Meadow, Shepperton, TW17 9HY

Proposed Development: It is understood that the development is for the demolition of the existing bungalow, followed by the construction of a replacement residential dwelling.

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1. Summary

- 1.1 Ambiantal Environmental Assessment has been appointed by Mr & Mrs Lees to undertake a National Planning Policy Framework (NPPF) compliant Flood Risk Assessment (FRA) for the proposed development at 4 Sandhills Meadow, Shepperton, TW17 9HY.
- 1.2 The site currently comprises of an existing bungalow. It is understood that the development is for the demolition of the existing bungalow, followed by the construction of a replacement residential dwelling. Plans of the proposed development are included in Appendix 1.
- 1.3 With reference to the Environment Agency (EA) Flood Map for Planning, the proposed development is located within Flood Zone 3. Analysis of EA modelled flood data indicates that the site is in Flood Zone 3b (Functional Floodplain), as it is affected by the modelled 1:20-year flood event.
- 1.4 The existing residential dwelling is considered “More Vulnerable” under Table 2 of the Flood Risk and Coastal Change Planning Practice Guidance and the principles of the National Planning Policy Framework (NPPF). There will be no change in flood risk vulnerability of the site post-development.
- 1.5 A summary of the flood risk and recommended mitigation measures is provided below:

Source	Description	
Fluvial	The EA Flood Map for Planning shows that the site is in Flood Zone 3 (high risk of fluvial flooding). The River Thames is located approximately 1m from the site and is fluvially dominated in this location. Using modelled flood outputs provided by the Environment Agency for the Lower Thames area, it is shown in the report that the site could be affected by flooding in the 1:20-year, 1:100-year, 1:100-year +35% climate change and 1:1,000-year events. As the site is affected by the 1:20-year extent, it is considered to be in Flood Zone 3b (Functional Floodplain). Residential development is not normally appropriate in Flood Zone 3b; however, given that the existing site comprises of a bungalow and the proposed replacement dwelling will be a 2-storey building with bedrooms at the first floor level, the development proposals could be considered as providing a betterment to the site and residents.	The ground floor Finished Floor Level of the proposed replacement dwelling will be set to 11.22mAOD, according to plans provided by the client. This is topographically greater than the 1:20-year and 1:100-year flood level. It also provides significant betterment compared to the existing dwelling. In the event of flooding at the site in an extreme weather event, safe refuge could be sought at the first-floor level. Given the proximity of the site to the River Thames, it is advised that residents seek evacuation from the site upon receipt of a Flood Warning and prior to flooding. The replacement dwelling should be constructed using flood resilient construction methods where possible, as detailed in Section 7 of the report.
Surface Water	The EA online Long-Term Flood Risk map for surface water demonstrates that the risk of flooding to the proposed site could be Very Low.	No mitigation measures required.

Groundwater	British Geological Survey data demonstrates that the risk of flooding from groundwater emergence at the proposed site is High.	The proposed replacement dwelling should be constructed using flood resilient construction methods where possible, as detailed in Section 7 of the report. For groundwater emergence, this includes constructing solid, waterproof flooring.
Sewer	Site is located in area affected by sewer flooding, according to historic data provided in Spelthorne SFRA.	Any new sewer connection created as part of the development proposals should be first agreed with the local sewer provider and fitted with non-return valves to mitigate the risk of sewer flooding.

Following the guidelines contained within the NPPF, the proposed development is considered to be suitable assuming appropriate mitigation (including adequate warning procedures) can be maintained for the lifetime of the development.

Development Description	Existing	Proposed
Development Type:	Existing bungalow	Demolition of existing bungalow and construction of replacement residential dwelling.
Number of Bedrooms:	N/A	3no. bedrooms
EA Vulnerability Classification:	More vulnerable	More vulnerable
Ground Floor Level:	Based on the topographic survey, levels on site are shown to vary between approximately 8.56mAOD and 9.90mAOD.	
Level of Sleeping Accommodation:	N/A	First floor level
Impermeable Surface Area:	N/A	
Surface Water Drainage:	N/A	Recommended that the surface runoff is discharged via the existing drainage infrastructure. Betterment could be provided by attenuating surface water runoff and temporarily storing water in a rainwater harvesting system, such as water butts or rain planters.
Site Size:	Approximately 272m ²	Same as existing
Risk to Development	Summary	Comment
EA Flood Zone:	3	
Flood Source:	Fluvial	River Thames
1:20-Year Flood Level	10.42mAOD	
1:100 Year Flood Level	11.07mAOD	
1:100 Year Flood Level & Climate Change (+35%)	11.60mAOD	Ambiental have used modelled flood outputs previously provided by the Environment Agency for this area (Lower Thames) to assess fluvial flood risk.
1:1000 Year Flood Level	11.65mAOD	
Recorded Flood Events in Area:	Yes	
Recorded Flood Events at Site:	Yes	According to records provided in Spelthorne SFRA
SFRA Available:	Yes	Spelthorne Borough Council SFRA (February 2018)
Management Measures	Summary	Comment
Ground floor level above extreme flood levels:	Yes	Ground floor FFL will be raised to 11.22mAOD which is topographically greater than the 1:20-year and 1:100-year flood levels.
Safe Access/Egress Route:	Yes	See Section 7
Flood Resilient Design:	Yes	See Section 7
Site Drainage Plan:	Yes	Discharge via existing drainage infrastructure.
Flood Warning & Evacuation Plan:	Yes	EA Flood Warning Service Area
Offsite Impacts	Summary	Comment
Displacement of floodwater:	None	VOIDS are to be incorporated into the proposed development
Increase in surface run-off generation:	Negligible	Any increase in surface water runoff should be dealt with through managing runoff on site.
Impact on hydraulic performance of channels:	None	Development does not impact channel

Table 1 Summary of flood risks, impacts and proposed flood mitigation measures.

N/A¹ not required for this assessment; N/A² data not available.

2. Development Description and Site Area

Proposed Development and Location

- 2.1 The proposed development is located at 4 Sandhills Meadow, Shepperton, TW17 9HY (Figure 1).
- 2.2 The site currently comprises of an existing bungalow. It is understood that the development is for the demolition of the existing bungalow, followed by the construction of a replacement residential dwelling. Plans of the proposed development are included in Appendix 1.
- 2.3 A topographic survey of the site has been provided by the client (see Appendix 1). Based on this topographic survey, levels on site are shown to vary between approximately 8.56mAOD and 9.90mAOD. The lowest level of 8.56mAOD is at the rear (east) boundary of the site. The majority of the site is considered to lie between 9.60mAOD and 9.90mAOD. The topographic survey is included in Appendix 1.

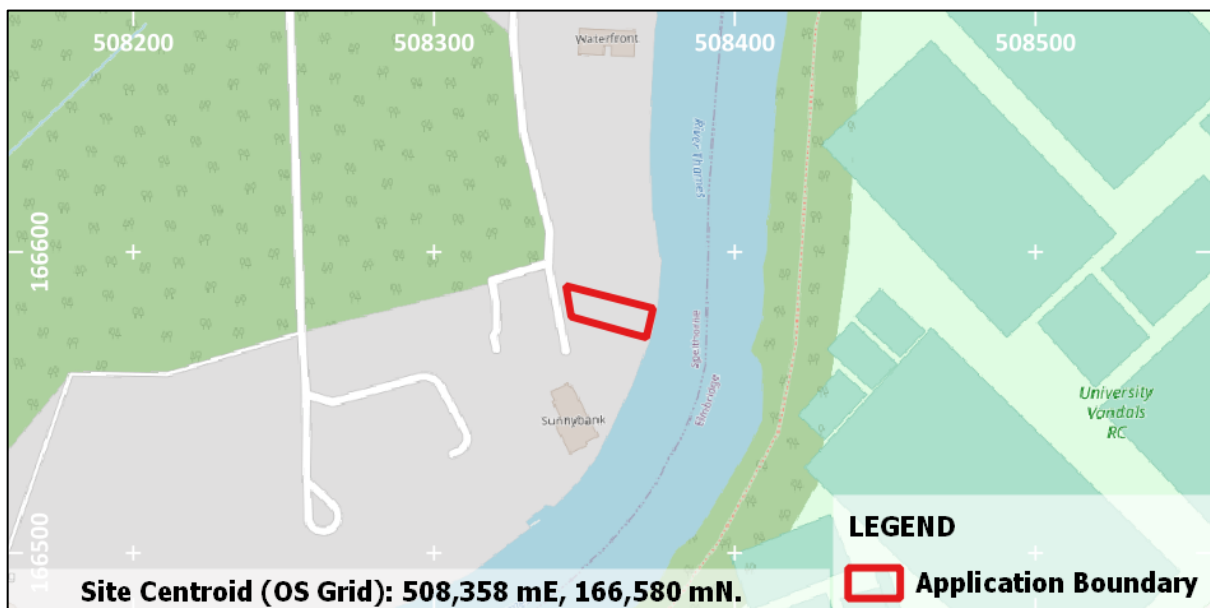


Figure 1 Location Map, identifying the location of the proposed development (Source: OS)

Vulnerability Classification

- 2.4 The online EA Flood Map for Planning (Figure 2) demonstrates that the proposed development lies within Fluvial Flood Zone 3 with a high probability of greater than 1 in 100 (>1%) of river flooding in any year.
- Flood Zone 1: areas have a low probability of less than 1 in 1,000 (<0.1%) of flooding from fluvial sources in any year;
 - Flood Zone 2: areas have a medium probability of between 1 in 100 and 1 in 1,000 (0.1% to 1%) of flooding from fluvial sources in any year;
 - Flood Zone 3: areas have a high probability of greater than 1 in 100 (>1%) of flooding from fluvial sources in any year.
- 2.5 Under Table 2 of the Flood Risk and Coastal Change Planning Practice Guidance and the principles of the National Planning Policy Framework (NPPF), the existing site is classified as 'More Vulnerable', due to its residential usage. The proposal is for the demolition of the existing dwelling and construction of a replacement dwelling. As such, post-development, the NPPF flood risk vulnerability will be unchanged compared to the existing situation.

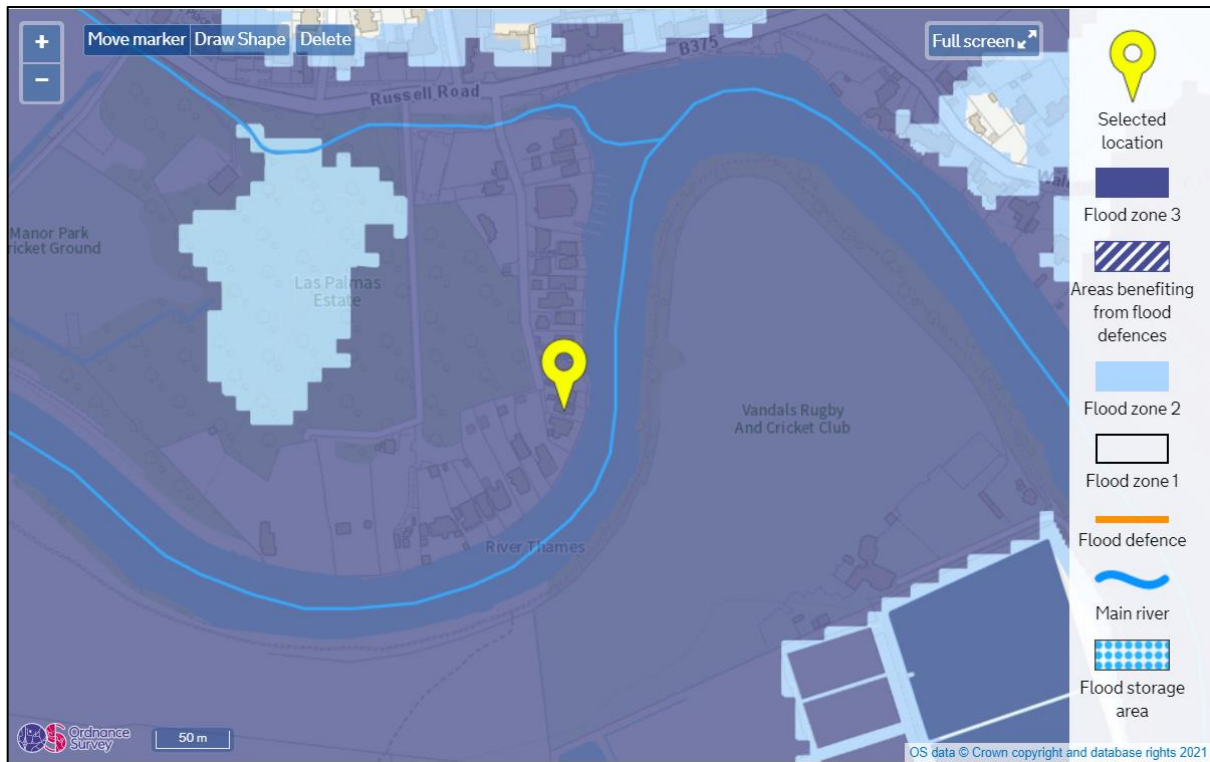


Figure 2: EA Flood Map for Planning, showing location of site (Source: EA)

Geology

- 2.6 The British Geological Survey (BGS) Geology of Britain Viewer indicates that the bedrock underlying the site is Claygate Member, comprising of sand, silt and clay (Source: BGS). The superficial deposits underlying the site are Alluvium, which comprises mainly of clay.
- 2.7 DEFRA's online MagicMap Aquifer Designation Maps indicate that the aquifer formations beneath both the bedrock and superficial deposits are considered to be Secondary 'A' aquifers. This is shown in Figure 3 (bedrock) and Figure 4 (superficial deposits) (Source: EA; Magic Map online resource). A Secondary 'A' aquifer is permeable, supporting water supplies at a local scale and may contribute to base flow of rivers.
- 2.8 Source protection zones are defined around large potable groundwater abstraction sites, and indicate the risk of contamination from activities in the vicinity of the abstraction site. The site is not within a Groundwater Source Protection Zone; however, as shown in Figure 5 below, the area on the opposite side of the River Thames is shown to be within a Zone I - Inner Protection Zone. There is a predicted travel-time of 50 days for pollutants below the water table to reach the abstraction point.

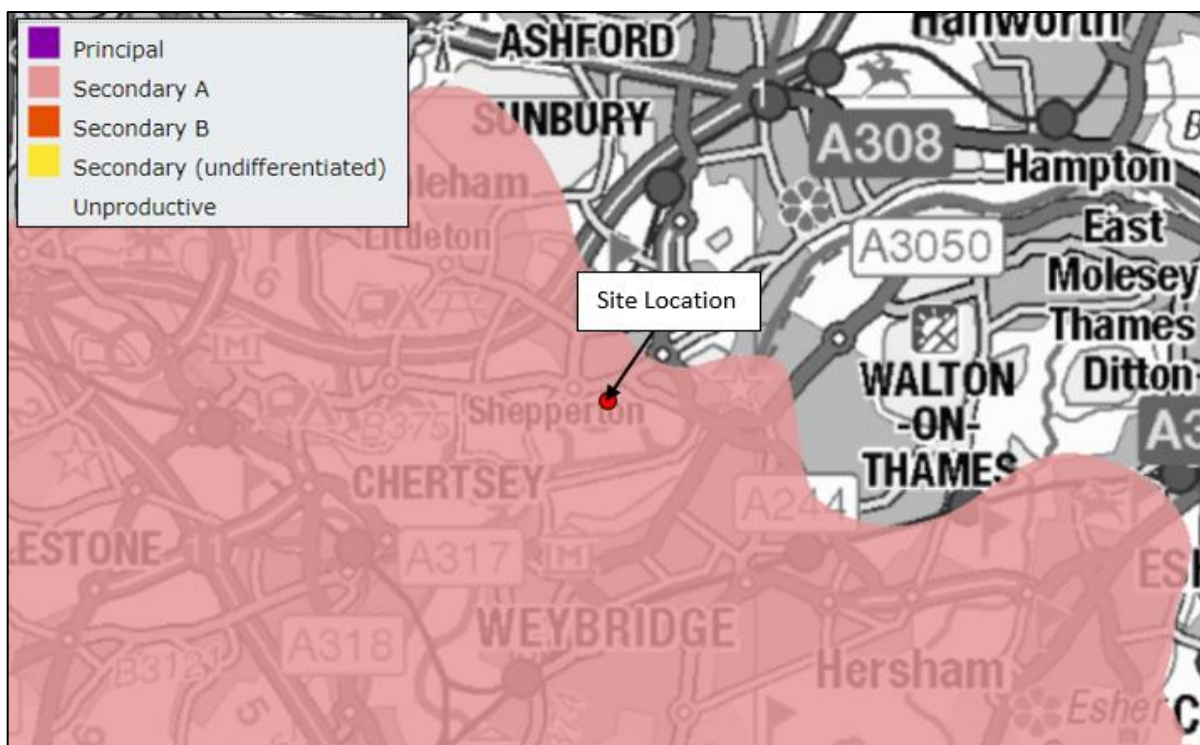


Figure 3: Aquifer Designation of Bedrock Geology, indicating location of site (Source: MagicMap online)

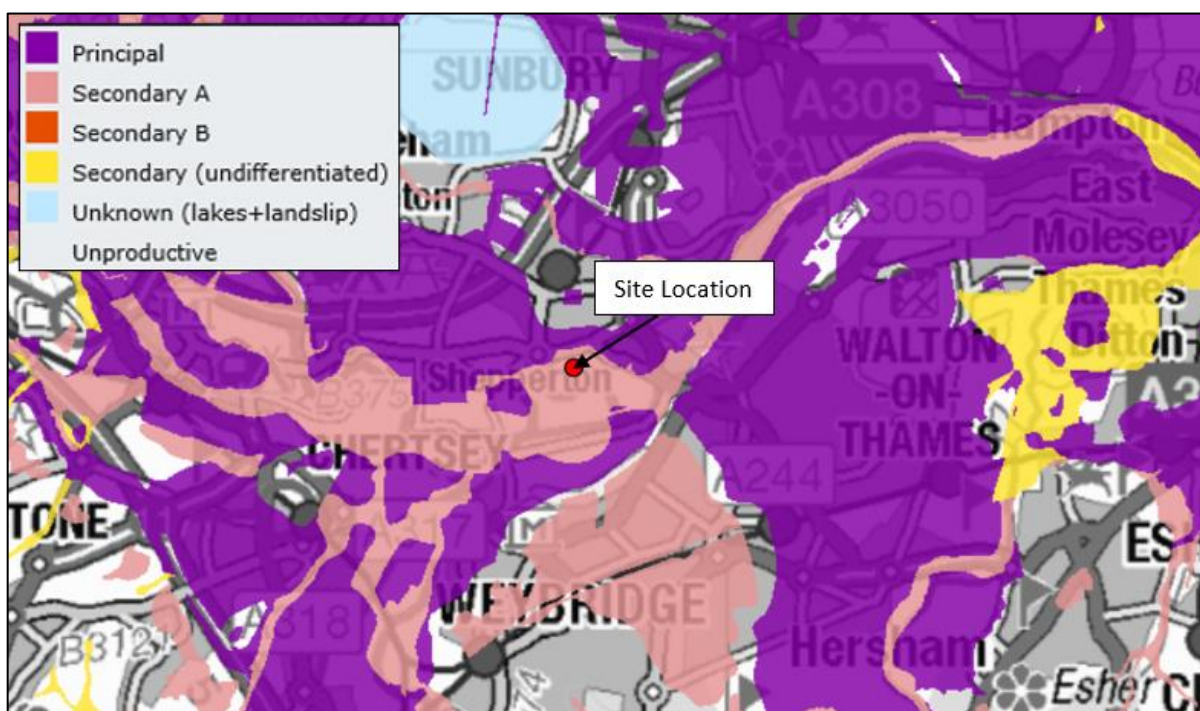


Figure 4: Aquifer Designation of Superficial Deposits, indicating location of site (Source: MagicMap online)



Figure 5: EA Groundwater Source Protection Zone, indicating location of site (Source: EA)

3. Sequential Test/Exception Test

- 3.1 Under the NPPF, all new planning applications should undergo a *Sequential Test*. This test should be implemented by local planning authorities with a view to locating particularly vulnerable new developments (e.g. residential, hospitals, mobile homes etc.) outside of the floodplain.
- 3.2 The Flood Risk and Coastal Change Planning Policy Guidance (PPG) *Flood Risk Vulnerability and Flood Zone 'Compatibility' Table* is reproduced below;

Flood Risk Vulnerability Classification		Essential Infrastructure	Water Compatible	Highly Vulnerable	More Vulnerable	Less Vulnerable
Flood Zone	Zone 1	✓	✓	✓	✓	✓
	Zone 2	✓	✓	Exception Test Required	✓	✓
	Zone 3a	Exception Test Required	✓	✗	Exception Test Required	✓
	Zone 3b <i>Functional Floodplain</i>	Exception Test Required	✓	✗	✗	✗

Table 2: Flood Risk Vulnerability and Flood Zone 'Compatibility' Table as specified by NPPF.
 Please note: ✓ means development is appropriate; ✗ means the development should not be permitted.

- 3.3 The proposed development is 'More Vulnerable' under the NPPF and PPG guidance, due to its residential usage. With reference to the EA Flood Map for Planning, the site is wholly in Flood Zone 3.
- 3.4 Using modelled flood outputs provided by the Environment Agency, it is demonstrated in Section 4 that the proposed development site lies wholly in Flood Zone 3b (Functional Floodplain). As per Table 2 above, 'More Vulnerable' developments are not normally appropriate in Flood Zone 3b.
- 3.5 As the site is in Flood Zone 3 and the development is 'More Vulnerable', a Sequential Test would normally be required. The proposed development is for the replacement of the existing dwelling on site. Thus, it could be argued that the proposal is for the replacement of the existing lawful use and should not require a Sequential Test.
- 3.6 Paragraph 164 of the revised National Planning Policy Framework (NPPF, 2021) states the following:
- The application of the exception test should be informed by a strategic or site-specific flood risk assessment, depending on whether it is being applied during plan production or at the application stage. To pass the exception test, it should be demonstrated that:*
- the development would provide wider sustainability benefits to the community that outweigh the flood risk; and*
 - the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.*
- 3.7 All developments in Flood Zones 2 and 3 require a site-specific flood risk assessment to be submitted alongside the planning application. Therefore, the proposed development is required to have a flood risk assessment, which demonstrates that the development will be safe for its lifetime without increasing flood risk elsewhere.

4. Site Flood Hazards

Sources of Flooding

- 4.1 The proposed development is located within Flood Zone 3 (high risk of flooding) and is considered to be 'More vulnerable' according to NPPF guidelines. Table 3 summarises the potential sources of flooding to the site:

Source	Description
Fluvial	High – Site is in Flood Zone 3b (Functional Floodplain); River Thames (fluvial)
Surface	Very Low
Groundwater	High
Sewer	Site is located in area affected by sewer flooding

Table 3 Summary of flood sources.

Fluvial

- 4.2 The site is wholly located in Flood Zone 3, so could be considered to be at high risk of flooding from fluvial sources, based on the EA Flood Map for Planning (Figure 2).
- 4.3 The River Thames, an EA main river, is located approximately 1m to the east of the development site.
- 4.4 The topographic survey, levels on site are shown to vary between approximately 8.56mAOD and 9.90mAOD. The lowest level of 8.56mAOD is at the rear (east) boundary of the site. The majority of the site is considered to lie between 9.60mAOD and 9.90mAOD. The topographic survey is included in Appendix 1.
- 4.5 Ambiental have previously been provided with modelled flood outputs for the Lower Thames area. These have been used to assess the fluvial flood risk to the site.
- 4.6 The modelled flood extents and levels for the following return periods have been provided:
- 1:20-year flood event
 - 1:100-year flood event
 - 1:100-year +35% climate change event (climate change allowances are discussed further in Section 5)
 - 1:1,000-year flood event
- 4.7 Figure 7 below shows the modelled flood extents for these assessed return periods. The proposed site boundary is shown to be affected by all of these modelled flood extents.
- 4.8 Flood levels have been extracted from within the site boundary and provided in Table 4 below. These have been compared with the topographic levels within the site boundary, to assess the potential flood depths that could affect the site.

	1:20-year	1:100-year	1:100-year +35% CC	1:1,000-year
Flood level at site	10.42mAOD	11.07mAOD	11.60mAOD	11.65mAOD
Topographic levels	9.60mAOD to 9.90mAOD	9.60mAOD to 9.90mAOD	9.60mAOD to 9.90mAOD	9.60mAOD to 9.90mAOD
Maximum flood depths	0.82m	1.47m	2.00m	2.05m

Table 4: Modelled flood levels extracted from within site boundary in assessed return periods (Source: EA)

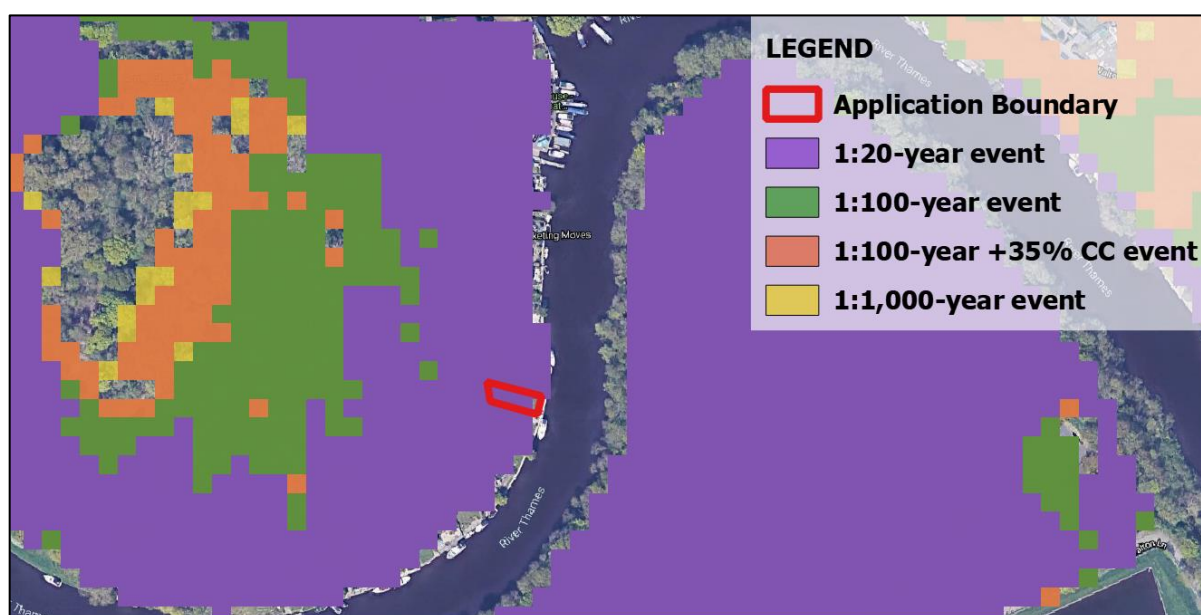


Figure 6: Modelled flood extents from Lower Thames modelling study, showing proposed site boundary (Source: EA)

4.9 A topographic survey of the site has been provided by the client (see Appendix 1). Based on this topographic survey, levels on site are shown to vary between approximately 8.56mAOD and 9.90mAOD. The lowest level of 8.56mAOD is at the rear (east) boundary of the site. Most of the site is considered to lie between 9.60mAOD and 9.90mAOD. The proposed replacement dwelling will be built in this part of the site.

4.10 A summary of the analysis is provided below:

- In the 1:20-year event, maximum flood depths of 0.82m could be experienced on site, due to a flood level of 10.42mAOD on site.
- During the 1:100-year event, flood depths of up to 1.47m could affect the site, due to a flood level of 11.07mAOD.
- During the 1:100-year +35% climate change flood event, the site could be affected by a flood level of 11.60mAOD, resulting in up to 2.00m of flood depths based on existing external ground levels.
- In the 1:1,000-year event, a flood level of 11.65mAOD could affect the site, which could result in up to 2.05m of flood depths.

- 4.11 The existing building on site is a bungalow, with sleeping accommodation and habitable uses all situated on the ground floor level.
- 4.12 The proposed replacement dwelling is a 2-storey building, with bedrooms provided at the first-floor level. Plans of the development indicate that the ground floor Finished Floor Level will be raised to 11.22mAOD. This is topographically greater than both the modelled 1:20-year and 1:100-year flood levels.
- 4.13 Further mitigation measures for the proposed replacement dwelling are provided in Section 7 of this report.

Surface Water (Pluvial)

- 4.14 The Environment Agency Flood Risk from Surface Water map (Figure 7) shows the proposed development to be within an area of 'Very Low' risk of flooding from surface water.
- 4.15 The following definitions of the annual surface water flood risk labels are given by the EA:
- 'High Risk'; >3.3% AEP (more often than 1 in 30);
 - 'Medium Risk'; 3.3% to 1.1% AEP (between 1 in 30 and 1 in 100);
 - 'Low Risk'; 1% to 0.1% AEP (between 1 in 100 and 1 in 1000);
 - 'Very Low Risk'; <0.1% AEP (less often than 1 in 1000).
- 4.16 As such, the risk of pluvial flooding to the proposed replacement dwelling could be considered to be very low.



Figure 7: EA Surface Water Flood Risk Map, indicating location of proposed development (Source: EA)

Groundwater

- 4.17 Ambiental have used the British Geological Society's (BGS) Susceptibility to Groundwater Emergence mapping to discern whether there is any potential risk of flooding from groundwater at the proposed site.
- 4.18 As shown in Figure 8, the site is located in an area identified as having 'Potential for groundwater flooding to occur at the surface', which is considered to be the highest risk category.

- 4.19 Therefore, the risk of flooding from groundwater emergence to the proposed replacement dwelling could be deemed to be high.

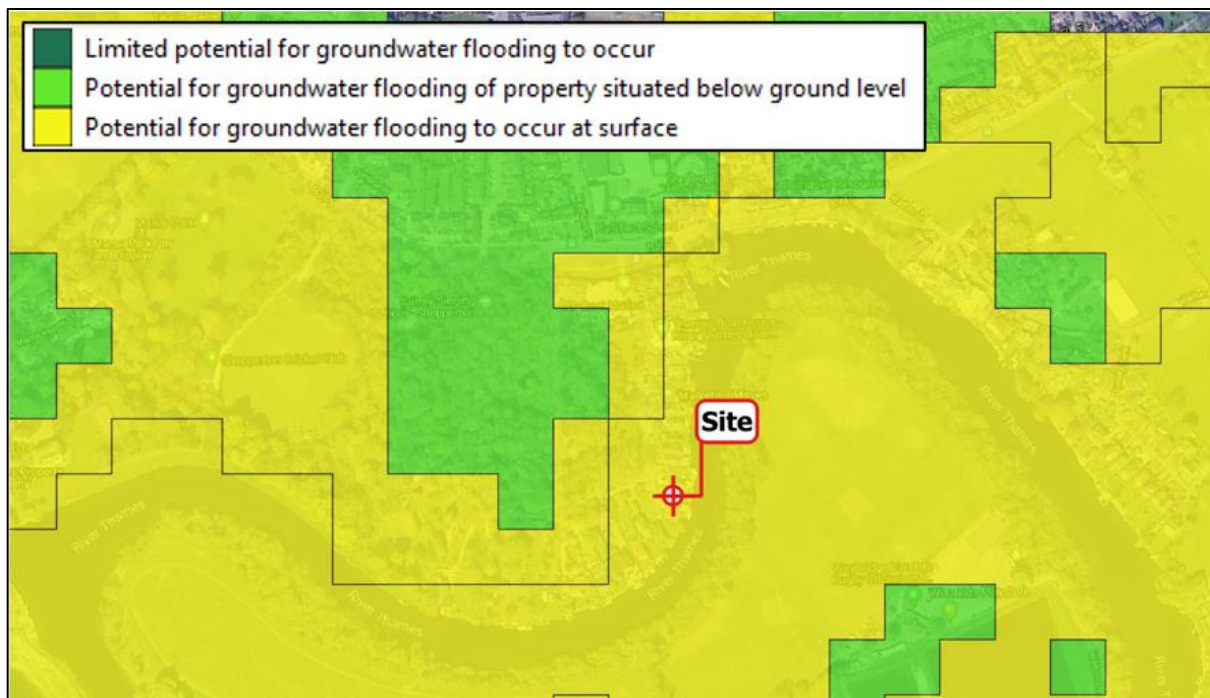


Figure 8: BGS Susceptibility to Groundwater Emergence mapping and location of proposed development

- 4.20 As previously indicated in Section 2 of the report, the site is not within a Groundwater Source Protection Zone; however, the area on the opposite side of the River Thames is shown to be within a Zone I - Inner Protection Zone.

Sewer

- 4.21 A Strategic Flood Risk Assessment was completed for Spelthorne Borough Council in 2018. Within this report are records of sewer flooding incidents which occurred in the borough area. Mapping of sewer flooding incidents according to postcode area has been provided in the SFRA. An extract of this mapping is shown in Figure 9 below, with an indication of the proposed site location. It indicates that the site is in an area which has been affected by 6 recorded sewer flooding incidents. Due to the nature of this information, it is not known whether the site itself has been affected by sewer flooding in the past.
- 4.22 Any new sewer connection created as part of the development proposals should be first agreed with the local sewer provider and fitted with non-return valves to mitigate the risk of sewer flooding.

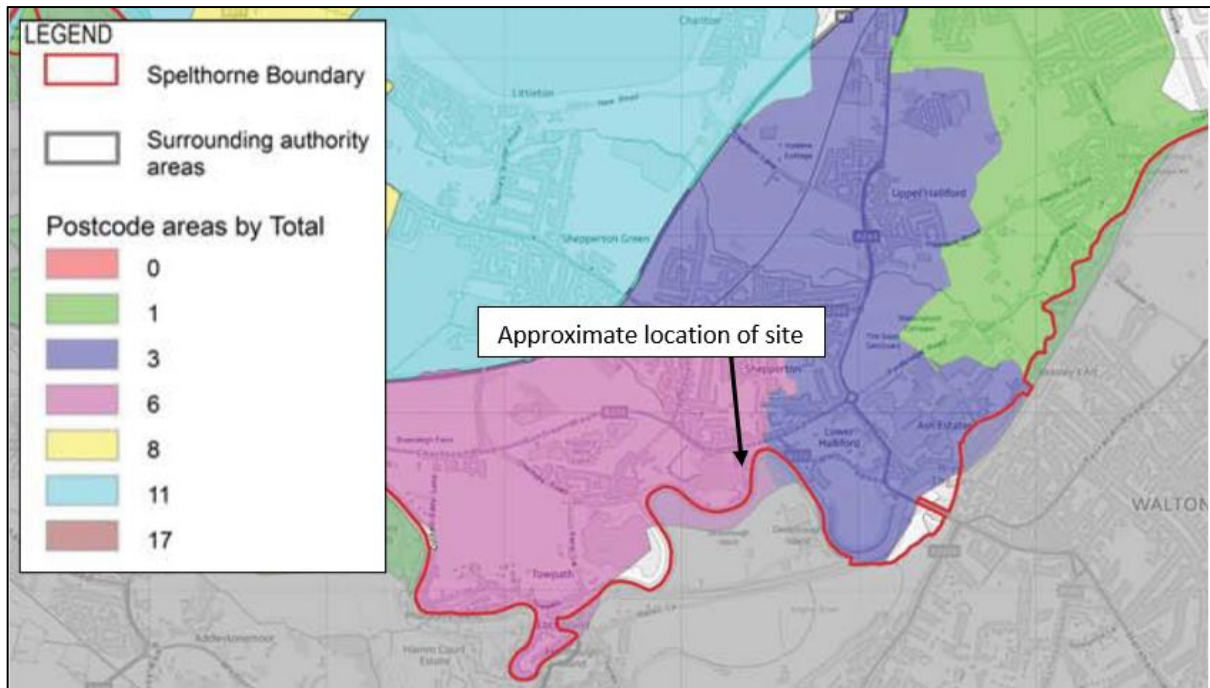


Figure 9: Sewer flood records from Spelthorne SFRA 2018, with location of site

Surface Water Drainage Strategy

- 4.23 The site currently comprises of an existing bungalow. It is understood that the development is for the demolition of the existing bungalow, followed by the construction of a replacement residential dwelling.
- 4.24 In order to mitigate flood risk posed by the proposed development, adequate control measures are required to be considered. This will ensure that surface water runoff is dealt with at source and the flood risk on/off site is not increased over the lifetime of the development.
- 4.25 The runoff generated will need to be managed in accordance with the National Planning Policy Framework (NPPF 2021) policy which requires the use of Sustainable Drainage Systems (SuDS). The design guidelines for the SuDS should follow the recommendations set out in Local guidance for Surrey, provided in the Surrey County Council SuDS Design Guidance (2019).
- 4.26 The management of surface water has been considered in respect to the SuDS hierarchy (Table 5 below) (as detailed in Building Regulations Part H and within the CIRIA 753 'The SUDS Manual', Section 3.2.3):

SuDS Drainage Hierarchy				
			Suitability	Comment
	1.	Infiltration	x	Poor levels of infiltration could be achieved at the site, due to naturally wet soil in this area (according to Soilscales online)
	2.	Discharge to Surface Water	✓	The River Thames neighbours the site, so a direct connection could be achieved.
	3.	Discharge to Surface Water Sewer, Highway Drain or another Drainage System	✓	The site currently benefits from positive drainage.

	4.	Discharge to Combined Sewer	-	
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Table 5: SuDS Hierarchy

4.27 To achieve the reduction in site run off rates, the use of various SuDS has been considered for the development as follows (Table 6):

Suitability of SuDS Components			
SuDS Component	Description	Constraints and Opportunities	Suitability
Infiltrating SuDS	Infiltration can contribute to reducing runoff rates and volumes while supporting baseflow and groundwater recharge processes. The suitability and infiltration rate depends on the permeability of the surrounding soils.	Site is located over clay. The soils underlying the site are 'Loamy and clayey floodplain soils with naturally high groundwater', with naturally wet soil (Figure 10; Source: Soilscales online). As such, poor levels of infiltration could be achieved at this site.	x
Permeable Pavement	Pervious surfaces can be used in combination with aggregate sub-base and/or geocellular/modular storage to attenuate and/or infiltrate runoff from surrounding surfaces and roofs. Liners can be used where ground conditions are not suitable for infiltration.	Permeable paving should be provided within suitable hardstanding areas.	✓
Green / Blue Roofs	Green Roofs provide areas of visual benefit, ecological value, enhanced building performance and the reduction of surface water runoff. They are generally more costly to install and maintain than conventional roofs but can provide many long-term benefits and reduce the on-site storage volumes.	Green/blue roofs may not be suitable for this site, as the proposed replacement dwelling has a pitched roof structure.	x
Rainwater Harvesting	Rainwater Harvesting is the collection of rainwater runoff for use. It can be collected from roofs or other impermeable areas, stored, treated (where required) and then used as a supply of water for domestic, commercial and industrial properties.	This could be a suitable method for this development.	✓
Swales	Swales are designed to convey, treat and attenuate surface water runoff and provide aesthetic and biodiversity benefits. They can replace conventional pipework as a means of conveying runoff, however space constraints of some sites can make it difficult incorporating them into the design.	There is limited space on the proposed site for large SuDS devices to be implemented, such as these.	x
Rills and Channels	Rills and Channels keep runoff on the surface and convey runoff along the surface to downstream SuDS components. They can be incorporated into the design to provide a visually appealing method of conveyance. They also provide effectiveness in pre-treatment removal of silts.		x
Bioretention Systems	Bioretention systems can reduce runoff rates and volumes and treat pollution using engineer soils and vegetation. They are particularly effective in delivering interception but can also be an attractive landscape feature whilst providing habitat and biodiversity.		x
Retention Ponds and Wetlands	Ponds and Wetlands are features with a permanent pool of water that provide both attenuation and treatment of surface water runoff. They enhance treatment processes and have great amenity and biodiversity benefits. Often a flow control system at the outfall controls the rates of discharge for a range of water levels during storm events.		x
Detention Basins	Detention Basins are landscaped depressions that are usually dry except during and immediately following storm events and can be used as a recreational or other amenity facility. They generally		x

	appropriate to manage high volumes of surface water from larger sites such as a neighbourhood.		
Geocellular Systems	Attenuation storage tanks are used to create a below-ground void space for the temporary storage of surface water before infiltration, controlled release or use. The inherent flexibility in size and shape means they can be tailored to suit the specific characteristics and requirements of any site.	If necessary, these could be provided to complement the other SuDS solutions.	✓
Proprietary Treatment Systems	Proprietary treatment systems are manufactured products that remove specific pollutants from surface water runoff. They are especially useful where site constraints preclude the use of other methods and can be useful in reducing the maintenance requirements of downstream SuDS.	If necessary, these could be provided to complement the other SuDS solutions.	x
Filter Drains and Filter Strips	Filter drains are shallow trenches filled with stone, gravel that create temporary subsurface storage for the attenuation, conveyance and filtration of surface water runoff. Filter strips are uniformly graded and gently sloping strips of grass or dense vegetation, designed to treat runoff from adjacent impermeable areas by promoting sedimentation, filtration and infiltration.	These may be used to provide interception drainage for overland flows from offsite.	x

Table 6: Suitability of SuDS Components

4.28 The site is positively drained as existing. Given that the proposal is for the replacement of the existing dwelling on site, it is recommended that the surface runoff is discharged via the existing drainage infrastructure. Betterment could be provided by attenuating surface water runoff and temporarily storing water in a rainwater harvesting system, such as water butts or rain planters. Water butts can provide non-potable water uses on site and rain planters can provide additional ecological benefits to the site.

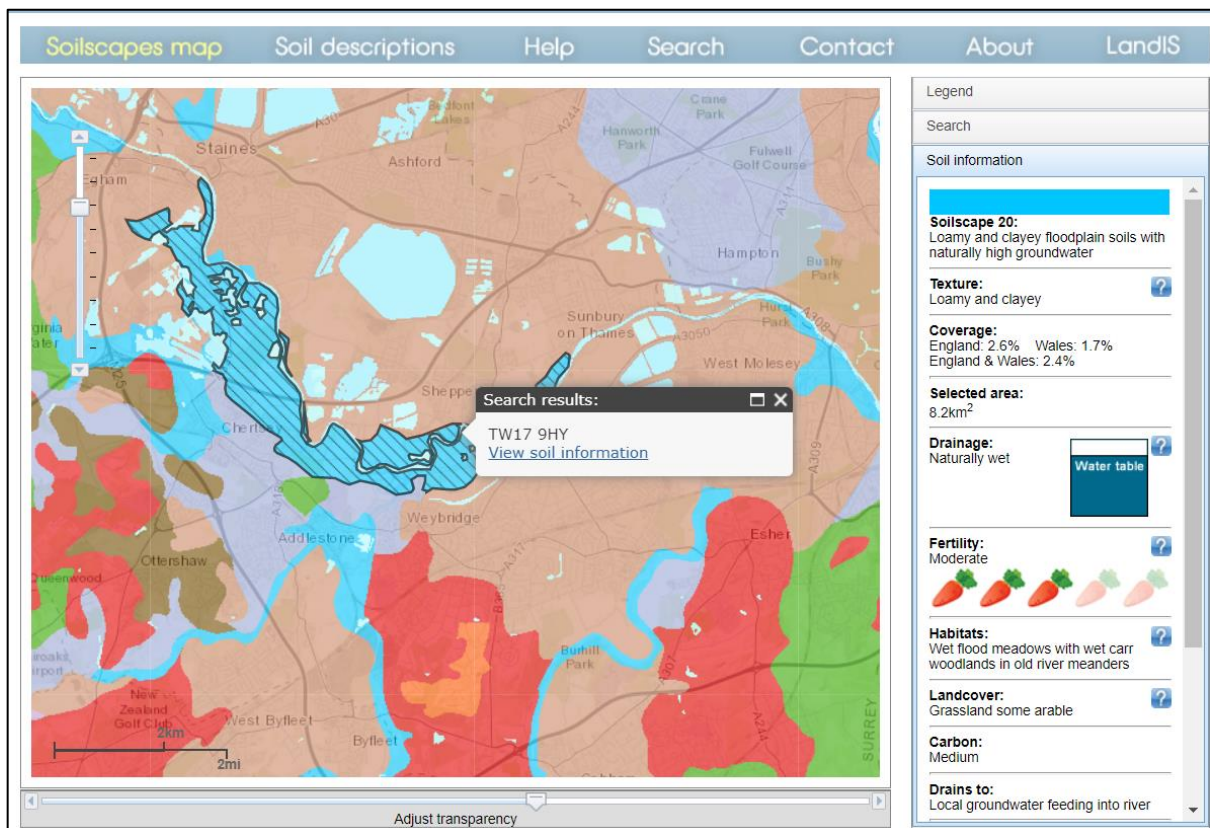


Figure 10: Extract of Soilsmap mapping showing location of postcode area for site (Source: Soilsmap)

Records of Historical Flooding

4.29 Environment Agency records for historic flooding show that the site is not in an area which has been affected by fluvial flooding in the past; however, the historic flood records provided in the Spelthorne SFRA (2018) show the site is in an area which was affected by flooding in the following events:

- 1968 September;
- 1974 November;
- 2003 January;
- Winter 2013-2014.

4.30 An extract of the SFRA's historic flood map and site location is shown in Figure 11. It is not known whether the site itself has been affected by flooding in the past.

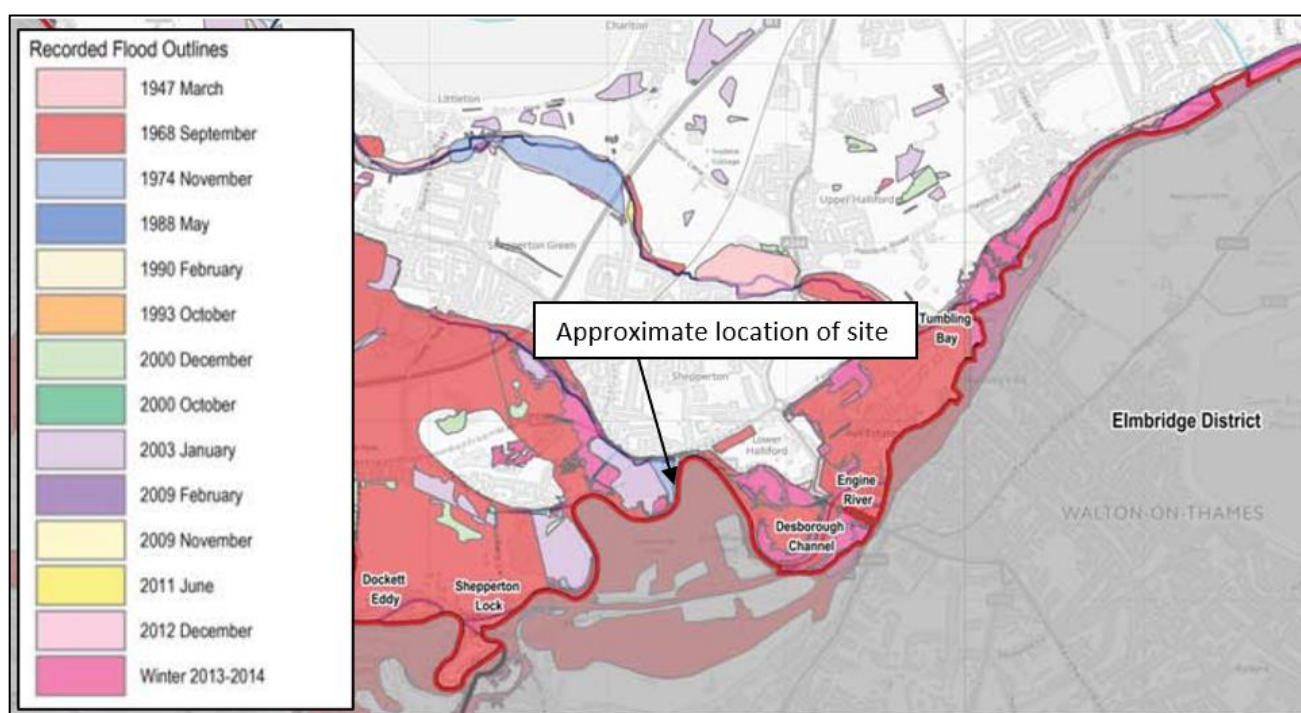


Figure 11: Extract from historic map in Spelthorne BC SFRA (2018), indicating approximate location of site

5. Probability of Flooding

Flood Zones

- 5.1 According to the EA Flood Map for Planning, the site is located within Flood Zone 3 (high risk of flooding).
- 5.2 The EA Flood Map for Planning has been produced in part using a relatively coarse, national scale flood modelling strategy, and in part by detailed modelling. It is important to note that only the potential floodplain is modelled; **the mitigating effects of any flood defences currently in place are not considered.** For reference, the definition of the NPPF flood risk zones is included below.

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

Table 7: Definition of the NPPF Flood Zones. (Source: EA)

Climate Change on Site

- 5.3 Climate change is likely to increase the flow in rivers, raise sea levels and increase storm intensity.
- 5.4 Peak river flow allowances show the anticipated changes to peak flow by management catchment. Management catchments are sub-catchments of river basin districts.
- 5.5 The range of allowances is based on percentiles. A percentile is a measure used in statistics to describe the proportion of possible scenarios that fall below an allowance level. The 50th percentile is the point at which half of the possible scenarios for peak flows fall below it and half fall above it.
- 5.6 The:
- central allowance is based on the 50th percentile
 - higher central is based on the 70th percentile
 - upper end is based on the 90th percentile
- 5.7 So, if the central allowance is 30%, scientific evidence suggests that it is just as likely that the increase in peak river flow will be more than 30% as less than 30%.
- 5.8 At the higher central allowance, 70% of the possible scenarios fall below this value. So, if the higher allowance is 40%, then current scientific evidence suggests that there is a 70% chance that peak flows will

increase by less than this value, but there remains a 30% chance that peak flows will increase by more (Source: EA).

- 5.9 The risk of flooding to the site would, therefore, be expected to increase following the effects of climate change. The likely increases in peak rainfall intensity would also lead to an increased risk of surface water flooding.
- 5.10 The proposed development site is in the Maidenhead and Sunbury management catchment, according to the Environment Agency.
- 5.11 The proposed development is 'More Vulnerable' (residential) and the site is in Flood Zone 3. The latest climate change guidance states that the Central allowance should be used to assess fluvial flood risk to development sites, when taking climate change into consideration. The EA climate change allowances for the Maidenhead and Sunbury management catchment, within the Thames river basin district, are provided in Table 5 below.

	Central	Higher	Upper
2020s	14%	19%	32%
2050s	17%	25%	45%
2080s	35%	47%	81%

Table 8: Peak river flow allowances in Maidenhead and Sunbury management catchment (Source: EA)

- 5.12 The lifetime of the proposed residential dwelling is 100 years, so the Central allowance in the 2080s period is used to assess climate change. For this management catchment area, this is associated with an increase in flow of +35%.
- 5.13 As previously indicated in the report in Section 4, the proposed development site could be affected by a modelled flood level of 11.60mAOD in the 1:100-year +35% climate change flood event. This could result in maximum flood depths of 2.00m on site, based on existing external ground levels.
- 5.14 To mitigate against flooding at the proposed residential dwelling, the ground floor Finished Floor Level will be raised to 11.22mAOD, according to plans provided by the client (see Appendix 1). This is lower than the 1:100-year +35% CC level of 11.60mAOD, by 0.38m. If a 1:100-year +35% CC flood event were to occur, residents could seek refuge at the first-floor level of the proposed replacement dwelling. This is a betterment when compared to the existing house on site, which is a bungalow.

6. Residual Risks

Identification of Residual Risks

6.1 Residual risks are those remaining after applying the sequential approach to the location of development and taking mitigating actions. Examples of residual flood risk include:

- the failure of flood management infrastructure such as a breach of a raised flood defence, blockage of a surface water conveyance system, overtopping of an upstream storage area, or failure of a pumped drainage system;
- failure of a reservoir, or;
- 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 which the drainage system cannot cope with.

Defence Breach

6.2 The EA Flood Map for Planning (Figure 2) does not indicate that the site is in an area which benefits from formal flood defences. Thus, the residual risk of flooding to the site in the event of breach or failure of flood defences could be considered very low.

Reservoir Failure

6.3 The EA Risk from Reservoir Flooding Map (Figure 12) demonstrates the site to be in an area with the potential of reservoir flooding. In the unlikely event that a reservoir dam fails, a large volume of water would escape at once with little or no warning. The EA predicts that floodwater on site would be greater than 2m deep. According to the EA, there has been no loss of life in the UK from reservoir flooding since 1925. All large reservoirs must be inspected and supervised by reservoir panel engineers as detailed by the enforcement authority for the Reservoirs Act 1975 in England. The EA are responsible to ensure that reservoirs are inspected regularly and essential safety work carried out. As reservoir flooding is unlikely and the modelled flood depths are based on the worst case scenario, flooding from this source may be considered as a relatively low risk.



Figure 12: EA Reservoir Flood Depths and location of site (Source: EA)

Drainage Exceedance

- 6.4 In the event of drainage failure/exceedance, overland flows would be dictated by site topography. External levels should be designed to fall away from ground floor thresholds to direct overland flow away from the property and provide some mitigation against drainage exceedance.

7. Flood Risk Management Measures

Flood Risks

- 7.1 The site currently comprises of an existing bungalow. It is understood that the development is for the demolition of the existing bungalow, followed by the construction of a replacement residential dwelling. Plans of the proposed development are included in Appendix 1.
- 7.2 Using modelled flood outputs provided by the Environment Agency for this area, it is demonstrated within the report that the proposed development site could be affected by flooding in the 1:20-year, 1:100-year, 1:100-year +35% CC and 1:1,000-year fluvial flood events.
- 7.3 The site is also located in an area at high risk of flooding from groundwater emergence.
- 7.4 Plans of the proposed replacement dwelling indicate that the ground floor Finished Floor Level will be set to 11.22mAOD. This is topographically greater than the 1:20-year and 1:100-year flood level.
- 7.5 Habitable rooms should be provided at the ground floor level (kitchen, dining room, studio, utility room, study and snug), with sleeping accommodation at the first-floor level. Sleeping accommodation should be raised a minimum of 600mm above the 1:100-year +35% CC flood level of 11.60mAOD, to a level no lower than 12.20mAOD. Standard floor to ceiling height is 2.2m. Thus, with the ground floor level of 11.22mAOD, the first-floor level could be expected to be at least 13.42mAOD. This is 1.22m higher than the recommended level.
- 7.6 Emergency safe refuge could be sought at the first-floor level, if required.
- 7.7 The site is in an EA Flood Alert/Warning Service Area, so residents should sign up to this service. In the event of an EA Flood Warning, the site shall be evacuated for the duration of the warning.
- 7.8 The proposed replacement dwelling should incorporate flood resilience measures in line with current best practice for construction within an area at risk of flooding in line with CLG 2007 'Improving the Flood Performance of New Buildings. These are outlined below.
- 7.9 The following mitigation measures are recommended for the proposed dwelling:
- Internal access should be maintained from the ground floor to the first floor, to allow for emergency safe refuge on site.
 - Construction:
 - Sleeping accommodation to be confined to the first floor.
 - Flood resilient measures such as airbrick covers to be installed.
 - Ground floor to be of solid construction, with waterproof membrane (where possible).
 - Damp proof membranes should be included within the design of the dwelling, to minimise the passage of water through ground floors. Impermeable polythene membranes should be at least 1200 gauge to minimise ripping. Effective methods of joining membrane sections are overlaps of 300mm, and also taping (mastic tape with an overlap of 50mm minimum). Care should be taken not to stretch the membrane in order to retain a waterproof layer.
 - All floors to be finished with waterproof screed (where possible).

- Wall cavities to be filled with closed-cell foam throughout.
- Ground floor internal render to be waterproof.
- Exterior ventilation outlets, utility points and air bricks to be fitted with removable waterproof covers.
- Electrical connection:
 - Ground floor electrical main ring to be run from first floor level and on separately switched circuit from first floor (where possible).
 - Electrical incomer and meter to be situated at first floor level.
- Gas / water supply:
 - Air source heat pump to be installed at first floor level (where possible).
 - Gas meter to be installed at first floor level (where possible).
 - All plumbing insulation to be of closed-cell design.
- Drainage:
 - Non-return valves to be fitted to all drain and sewer outlets.
 - Manhole covers to be secured.
 - Anti-syphon fitted to all toilets.
- Interior fittings:
 - Kitchen units to be of solid, water resistant material.
 - Units to be raised on legs above plinth.
 - Use of MDF carpentry (i.e. skirting, architrave, built-in storage) to be avoided at ground floor level.
- Site owners/ staff/ management/residents will be required to sign up to the EA Flood Warning Service.

Flood Warning Service

- 7.10 It is recommended that residents are aware of the EA Flood Information service which identifies whether any flood warnings or alerts have been issued for a specific postcode or place in England or Wales: <https://flood-warning-information.service.gov.uk/>.
- 7.11 During periods of bad weather, site users should monitor local weather reports and sign up for the Met Office UK weather warnings. Warnings can be monitored through an Apple/Android app, Twitter or directly via emails. Further information can be found at <https://www.metoffice.gov.uk/>.
- 7.12 The EA operates a 24-hour telephone service on 0345 988 1188 that provides frequently updated flood warnings and associated floodplain information. Further information can be found on <https://flood-warning-information.service.gov.uk/warnings>. Floodline Warnings Direct is a free service operated by the EA that provides flood warnings direct to occupants by telephone, mobile phone, fax or pager.

- 7.13 The proposed development site is located within an EA Flood Warning Service Area (Figure 13). As such, it is recommended that site users sign up to this service.

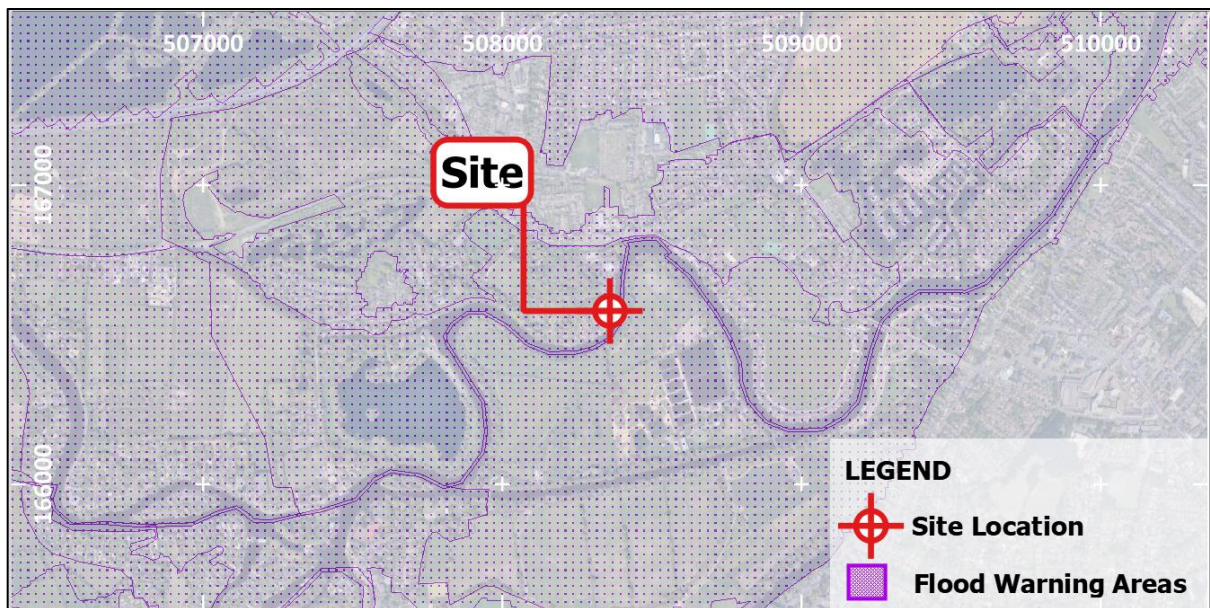


Figure 13: EA Flood Warning Service Area, showing location of site (Source: EA)

- 7.14 Upon receipt of a Flood Warning, site users are advised to evacuate the site to a designated place of safe refuge within Flood Zone 1.
- 7.15 If flood waters along the proposed evacuation route have exceed 25cm, site users are advised, if possible, to seek refuge at the upper floors on site.

What to do if you receive a Flood Alert

- 7.16 A flood alert means you need to prepare, flooding is possible. You should:

- check your flood risk - <https://flood-warning-information.service.gov.uk/long-term-flood-risk>
- sign up for flood warnings - <https://www.gov.uk/sign-up-for-flood-warnings>
- keep up to date with the latest situation - call Floodline on 0345 988 1188 or follow @EnvAgency and #floodaware on Twitter for the latest flood updates
- have a bag ready with vital items like insurance documents and medications in case you need to leave your home
- check you know how to turn off your gas, electricity and water mains supplies
- plan how you'll move family and pets to safety



What to do if you receive a Flood Warning

- 7.17 A flood warning means you need to act, flooding is expected. You should do all the actions for a flood alert but also:

- move vehicles to higher ground if it's safe to do so
- move family and pets to safety



- move important items upstairs or to a safe place in your property, starting with cherished items and valuables, then furniture and furnishings
- turn off gas, electricity and water supplies if it's safe to do so; never touch an electrical switch if you're standing in water
- if you have property protection products such as flood barriers, or air brick covers, use them now
- keep track of the latest situation - <https://flood-warning-information.service.gov.uk/warnings>

What to do if you receive a Severe Flood Warning

7.18 A severe flood warning means there is danger to life: you must act now:

- call 999 if you're in immediate danger
- follow advice from the emergency services and evacuate if you're told to do so
- make sure you have an emergency kit including a torch, spare batteries, mobile phone and charger, warm clothes, important numbers like your home insurance, water, food, first aid kit and any medicines and baby care items you may need
- alert neighbours and offer help if it's safe to do so
- avoid driving or walking through flood water: just 30cm (1 foot) of fast flowing water could move your car and even shallow moving water can knock you off your feet
- keep your family and pets away from floodwater – it may contain heavy debris, sharp objects, open manhole covers, sewage and chemicals
- wash your hands if you've been in contact with flood water which may contain toxic substances



Flood Evacuation Plan

- 7.19 As with all Flood Evacuation Plans, in the first instance, all residents and occupants should always defer to, and cooperate with, the direction provided by "Blue Light Responders". This is especially true in areas which under normal circumstances would be protected by flood defences.
- 7.20 Upon receipt of a Flood Warning, site users are advised to evacuate the site to a designated place of safe refuge.
- 7.21 Based on the EA Flood Zone extents, a recommended evacuation route from the site to a place of safe refuge in Flood Zone 1 has been provided in Figure 14. It is recommended that residents leave the site and head northwards along Sandhills Meadow road. At the T-junction, they should turn right onto the B3785 / Russell Road, before turning right at the roundabout and heading down Walton Lane. They should continue along Walton Lane until the next roundabout, whereby it is advised that evacuees take the second exit onto the A244, heading southeast bound. They then cross over the River Thames via Walton Bridge and continue along the A244 until they reach a suitable place of refuge. There are several suitable places in this area, including a shopping centre and several schools. As indicated in Figure 14 below, this area is in Flood Zone 1. There are also well-connected bus routes to other areas in Flood Zone 1.

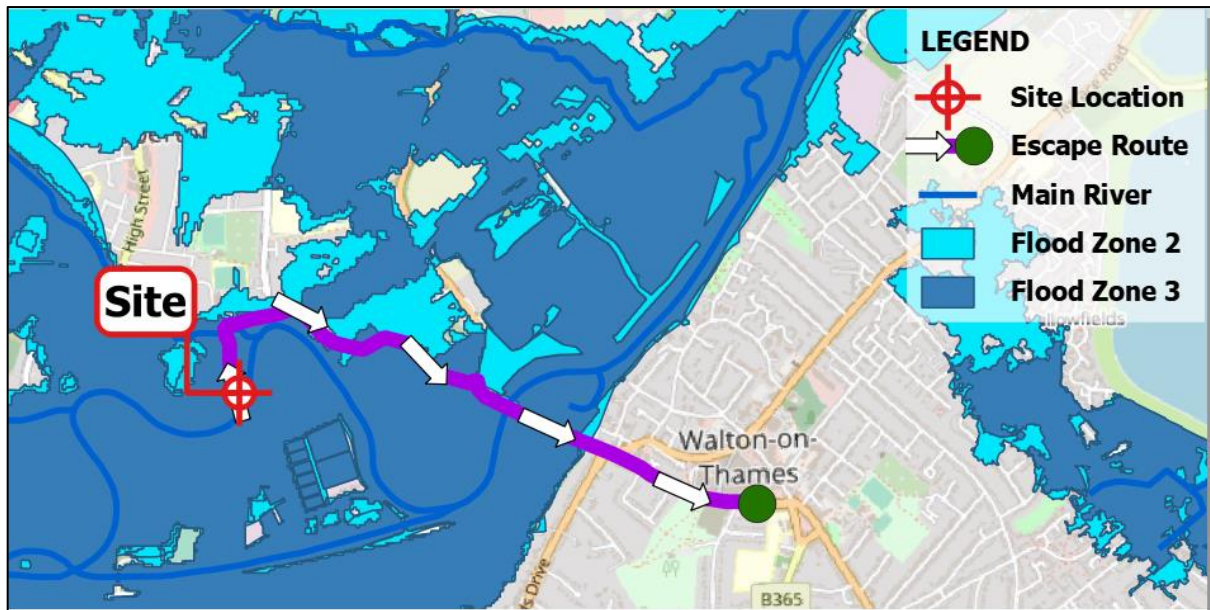


Figure 14: Recommended evacuation route using EA Flood Zone extents (Source: EA)

7.22 Ambiental have also used flood hazard grids for the 1:100-year +35% climate change event, previously provided by the Environment Agency for this area, to demonstrate that this evacuation route takes residents and evacuees to an area with a low flood hazard. The site is located in an area with a hazard rating of 1.25 to 2.00, which corresponds with the classification of 'Danger for Most – includes the general public'. This is according to the classifications provided in DEFRA's Flood Risk to People guidance document. As shown in Figure 15 below, the proposed evacuation route takes evacuees to an area with a flood hazard rating lower than 0.50, which is considered to be a very low/negligible hazard.

7.23 The flood hazard classifications are shown in Table 9 below.

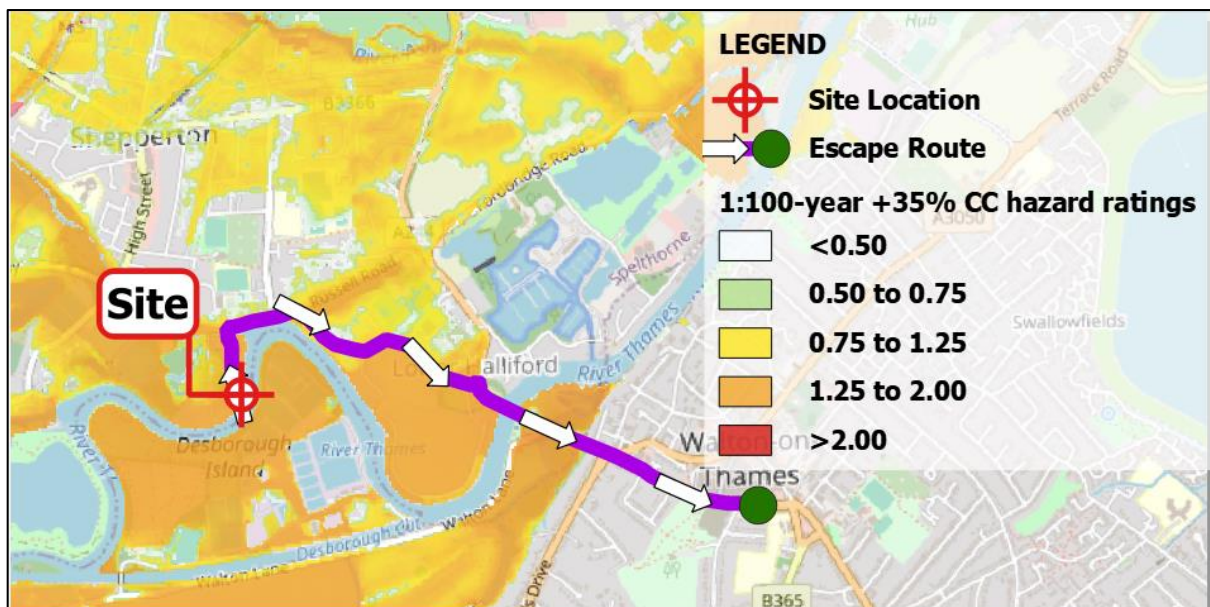


Figure 15: Recommended evacuation route with flood hazard ratings for 1:100-year +35% CC event (Source: EA; OpenStreet map)

Flood Hazard	Colour	Hazard to People Classification
Less than 0.75	Green	Very low hazard - Caution
0.75 to 1.25	Yellow	Danger for some - includes children, the elderly and the infirm
1.25 to 2.0	Orange	Danger for most - includes the general public
More than 2.0	Red	Danger for all - includes the emergency services

Table 9: Flood hazard ratings and classifications from DEFRA's Flood Risk to People document

- 7.24 Given the flood hazard classifications at the site and along most of the recommended evacuation route are identified as 'Danger for Most – includes the general public', if flood depths are above 25cm along the evacuation route, residents and evacuees should not use these routes. In this instance, it is recommended that they remain on site and seek refuge at the first-floor level of the proposed replacement dwelling.
- 7.25 It should be noted that the development proposal is for the replacement of the existing bungalow to provide a two-storey dwelling. Therefore, it is considered that there is a betterment to the site, as residents would be able to seek refuge at the first-floor level.

8. Off Site Impacts

Impact to Flood Risk Elsewhere

- 8.1 The proposed development is for the demolition of the existing dwelling on site, followed by the construction of a replacement building. The development is proposed to be constructed on voids, which will provide significant betterment compared to the existing dwelling which does not incorporate any voids or other mitigation measures.
- 8.2 As part of the development, a void management plan should be implemented to ensure the voids remain open and functional for the lifetime of the development.
- Voids will be visually inspected by residents/building management on a weekly basis to ensure there are no sudden obstructions to the openings, or impediments to the potential capacity (i.e. incorrectly stored items, debris, incorrectly parked vehicles etc.). Any material that is placed in front of the voids must be removed immediately.
 - A monthly maintenance programme will ensure the voids are kept clear - silt etc. will be cleared away, and vegetation cleared from void openings.
 - A regular engineer's inspection will be commissioned to ensure the voids are structurally sound, and fit for purpose. In the event that any steel bars are damaged or bent they should be rectified, if they cannot be repaired then should be replaced like for like.
 - After this inspection, the building management/owner will write to the local authority to assure them that the voids are fully functional in line with the planning permission.

Period	Inspection	Action
Weekly	Material blocking the voids	Remove material
Monthly	Carry out routine inspection for obstructions or damage	Remove obstruction and repair/replace damaged sections
Annual	Inspect steel bars or damage to any structural part of the void	Repair/replace damaged sections
	Carry out visual inspection of the void space for siltation or debris	If there are signs of debris such as leaves or other detritus, they should be removed immediately
	Inspect for any evidence of vermin	Eradicate vermin (if any)
5 yearly	Carry out regular weekly/monthly/annual inspections	Remedy as above
	Commission an Engineers structural inspection to ensure voids are structurally sound and fit for purpose	Repair/replace damaged sections
	Remove access panels for visual inspection	Remove any debris and silt build up, scrape back to ensure minimum amount of clear space between the underside of the slab and the ground
Post Flooding	Carry out full inspection as detailed above	As soon as practically possible after a flood event. Remedy as above

Table 10: Maintenance Summary Table

Generation of Runoff

- 8.3 The site currently comprises of an existing bungalow. It is understood that the development is for the demolition of the existing bungalow, followed by the construction of a replacement residential dwelling.
- 8.4 In order to mitigate flood risk posed by the proposed development, adequate control measures are required to be considered. This will ensure that surface water runoff is dealt with at source and the flood risk on/off site is not increased over the lifetime of the development.
- 8.5 The site is positively drained as existing. Given that the proposal is for the replacement of the existing dwelling on site, it is recommended that the surface runoff is discharged via the existing drainage infrastructure. Betterment could be provided by attenuating surface water runoff and temporarily storing water in a rainwater harvesting system, such as water butts or rain planters. Water butts can provide non-potable water uses on site and rain planters can provide additional ecological benefits to the site.

9. Conclusion

- 9.1 Ambiental Environmental Assessment has been appointed by Mr & Mrs Lees to undertake a National Planning Policy Framework (NPPF) compliant Flood Risk Assessment (FRA) for the proposed development at 4 Sandhills Meadow, Shepperton, TW17 9HY.
- 9.2 The site currently comprises of an existing bungalow. It is understood that the development is for the demolition of the existing bungalow, followed by the construction of a replacement residential dwelling. Plans of the proposed development are included in Appendix 1.
- 9.3 With reference to the Environment Agency (EA) Flood Map for Planning, the proposed development is located within Flood Zone 3. Analysis of EA modelled flood data indicates that the site is in Flood Zone 3b (Functional Floodplain), as it is affected by the modelled 1:20-year flood event.
- 9.4 The existing residential dwelling is considered “More Vulnerable” under Table 2 of the Flood Risk and Coastal Change Planning Practice Guidance and the principles of the National Planning Policy Framework (NPPF). There will be no change in flood risk vulnerability of the site post-development.
- 9.5 A summary of the flood risk and recommended mitigation measures is provided below:

Source	Description	
Fluvial	The EA Flood Map for Planning shows that the site is in Flood Zone 3 (high risk of fluvial flooding). The River Thames is located approximately 1m from the site, and is fluvially dominated in this location. Using modelled flood outputs provided by the Environment Agency for the Lower Thames area, it is shown in the report that the site could be affected by flooding in the 1:20-year, 1:100-year, 1:100-year +35% climate change and 1:1,000-year events. As the site is affected by the 1:20-year extent, it is considered to be in Flood Zone 3b (Functional Floodplain). Residential development is not normally appropriate in Flood Zone 3b; however, given that the existing site comprises of a bungalow and the proposed replacement dwelling will be a 2-storey building with bedrooms at the first floor level, the development proposals could be considered as providing a betterment to the site and residents.	The ground floor Finished Floor Level of the proposed replacement dwelling will be set to 11.22mAOD, according to plans provided by the client. This is topographically greater than the 1:20-year and 1:100-year flood level. In the event of flooding at the site in an extreme weather event, safe refuge could be sought at the first-floor level. Given the proximity of the site to the River Thames, it is advised that residents seek evacuation from the site upon receipt of a Flood Warning and prior to flooding. The replacement dwelling should be constructed using flood resilient construction methods where possible, as detailed in Section 7 of the report.
Surface Water	The EA online Long-Term Flood Risk map for surface water demonstrates that the risk of flooding to the proposed site could be Very Low.	No mitigation measures required.

Groundwater	British Geological Survey data demonstrates that the risk of flooding from groundwater emergence at the proposed site is High.	The proposed replacement dwelling should be constructed using flood resilient construction methods where possible, as detailed in Section 7 of the report. For groundwater emergence, this includes constructing solid, waterproof flooring.
Sewer	Site is located in area affected by sewer flooding, according to historic data provided in Spelthorne SFRA.	Any new sewer connection created as part of the development proposals should be first agreed with the local sewer provider and fitted with non-return valves to mitigate the risk of sewer flooding.

Following the guidelines contained within the NPPF, the proposed development is considered to be suitable assuming appropriate mitigation (including adequate warning procedures) can be maintained for the lifetime of the development.

Appendix I - Site Plans

Appendix II - EA Data

Appendix III - Supplementary Information