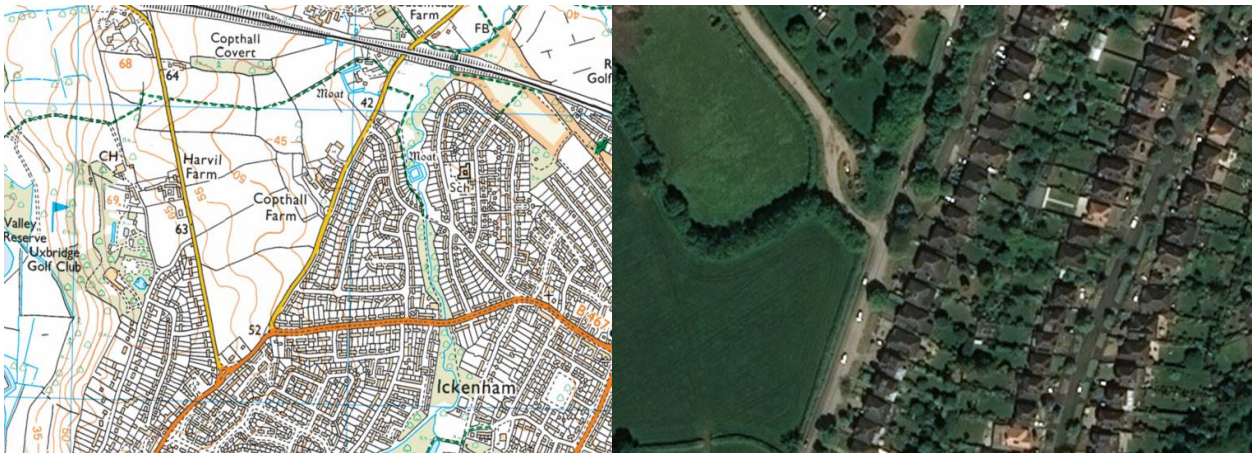




Flood Risk Assessment

62 Breakspear Road South, Ickenham, UB10 8HE



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1 Introduction

National planning policy and, increasingly, local planning policy require a Flood Risk Assessment (FRA) to support development planning applications. In particular, to demonstrate how risks from all sources of flooding to the site and elsewhere will be managed.

This report details the FRA in respect of development proposals for 62 Breakspear Road South, Ickenham, UB10 8HE. A full assessment of the flood risk to the site and consideration of the surface water management as a result of the development has been considered as part of this analysis.

Data has been analysed from a number of sources to inform this assessment, including: the Environment Agency (EA), the British Geological Society (BGS), National Soil Research Institute (NSRI), Ordnance Survey (OS), commercially available historical mapping and relevant strategic documents developed by London Borough of Hillingdon, in their capacity as the Lead Local Flood Authority and Local Planning Authority.

2 Policy Requirements

2.1 National Planning Policy

Paragraph 163 of the National Planning Policy Framework (NPPF) states “When determining any planning applications, local planning authorities should ensure that flood risk is not increased elsewhere. Where appropriate, applications should be supported by a site-specific flood-risk assessment⁵⁰. Development should only be allowed in areas at risk of flooding where, in the light of this assessment (the sequential and exception tests, as applicable) it can be demonstrated that:

- a) within the site, the most vulnerable development is located in areas of lowest flood risk, unless there are overriding reasons to prefer a different location;
- b) the development is appropriately flood resistant and resilient;
- c) it incorporates sustainable drainage systems, unless there is clear evidence that this would be inappropriate;
- d) any residual risk can be safely managed; and
- e) safe access and escape routes are included where appropriate, as part of an agreed emergency plan”.

Footnote 50 states “A site-specific flood risk assessment should be provided for all development in Flood Zones 2 and 3. In Flood Zone 1, an assessment should accompany all proposals involving: sites of 1 hectare or more; land which has been identified by the Environment Agency as having critical drainage problems; land identified in a strategic flood risk assessment as being at increased flood risk in future; or land that may be subject to other sources of flooding, where its development would introduce a more vulnerable use”.

Furthermore paragraph 30 of the Planning Practice Guide on Flood Risk and Climate Change states “A site-specific flood risk assessment is carried out by (or on behalf of) a developer to assess the flood risk to and from a development site. Where necessary, the assessment should

accompany a planning application submitted to the local planning authority. The assessment should demonstrate to the decision-maker how flood risk will be managed now and over the development's lifetime, taking climate change into account, and with regard to the vulnerability of its users.

The objectives of a site-specific flood risk assessment are to establish:

- whether a proposed development is likely to be affected by current or future flooding from any source;
- whether it will increase flood risk elsewhere;
- whether the measures proposed to deal with these effects and risks are appropriate;
- evidence for the local planning authority to apply (necessary) the Sequential Test, and;
- whether the development will be safe and pass the Exception Test, if applicable".

Continuing paragraph 31 of the Planning Practice Guidance quotes "The information provided in the flood risk assessment should be credible and fit for purpose. Site-specific flood risk assessments should always be proportionate to the degree of flood risk and make optimum use of information already available, including information in a Strategic Flood Risk Assessment for the area, and the interactive flood risk maps available on the Environment Agency's web site.

A flood risk assessment should also be appropriate to the scale, nature and location of the development. For example, where the development is an extension to an existing house (for which planning permission is required) which would not significantly increase the number of people present in an area at risk of flooding, the local planning authority would generally need a less detailed assessment to be able to reach an informed decision on the planning application. For a new development comprising a greater number of houses in a similar location, or one where the flood risk is greater, the local planning authority would need a more detailed assessment".

2.2 Local Planning Policy

Local Authorities consider flood risk through relevant environmental and climate change policies which enforce the requirements of the NPPF. Relevant local policy, as outlined by London Borough of Hillingdon, is contained within the;

- i) Strategic Flood Risk Assessment
- ii) Local Flood Risk Management Strategy

The Strategic Flood Risk Assessment (SFRA) and the Local Flood Risk Management Strategy (LFRMS) are key sources of flood risk specific information for the area. The SFRA provides a more detailed review of flood risks and recommendations for ensuring developments can be constructed and operated safely in accordance with the NPPF. Furthermore, reference to the London Plan Policy 5.12 is considered within this assessment.

2.3 Flood Risk Zones, Vulnerability and Classification

These Flood Zones refer to the probability of river and sea flooding, ignoring the presence of defences. They are shown on the Environment Agency's Flood Map for Planning available on the Environment Agency's web site, as indicated in the table below.

Table 1 - Flood Zones

Flood Zone	Definition
Zone 1 <i>Low Probability</i>	Land having a less than 1 in 1,000 annual probability of river or sea flooding. (Shown as 'clear' on the Flood Map – all land outside Zones 2 and 3)
Zone 2 <i>Medium Probability</i>	Land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or Land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding. (Land shown in light blue on the Flood Map)
Zone 3a <i>High Probability</i>	Land having a 1 in 100 or greater annual probability of river flooding; or Land having a 1 in 200 or greater annual probability of sea flooding. (Land shown in dark blue on the Flood Map)
Zone 3b <i>The Functional Floodplain</i>	This zone comprises land where water has to flow or be stored in times of flood. Local planning authorities should identify in their Strategic Flood Risk Assessments areas of functional floodplain and its boundaries accordingly, in agreement with the Environment Agency. (Not separately distinguished from Zone 3a on the Flood Map)

Table 2 - Flood Risk Vulnerability Classification

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.
Water Compatible Development
- Flood control infrastructure. - Water transmission infrastructure and pumping stations. - Sewage transmission infrastructure and pumping stations. - Sand and gravel working. - Docks, marinas and wharves. - Navigation facilities. - Ministry of Defence 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.

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

Table 3 - Flood risk vulnerability and flood zone 'compatibility'

Flood Zones	Flood Risk Vulnerability Classification				
	Essential Infrastructure	Highly Vulnerable	More Vulnerable	Less Vulnerable	Water Compatible
Zone 1	✓	✓	✓	✓	✓
Zone 2	✓	Exception Test required	✓	✓	✓
Zone 3a†	Exception Test required†	X	Exception Test required	✓	✓
Zone 3b*	Exception Test required*	X	X	X	✓*

Key:

✓ Development is appropriate

X Development should not be permitted.

Notes to *Table 3*:

- This table does not show the application of the Sequential Test which should be applied first to guide development to Flood Zone 1, then Zone 2, and then Zone 3; nor does it reflect the need to avoid flood risk from sources other than rivers and the sea;
- The Sequential and Exception Tests do not need to be applied to minor developments and changes of use, except for a change of use to a caravan, camping or chalet site, or to a mobile home or park home site;
- 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.

† 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.

2.4 Minor development in context of Planning Practice Guidance

Section 17 of the Planning Practice Guidance for Flood Risk and Coastal Change defines minor development as:

- minor non-residential extensions with a footprint less than 250 square metres;
- development that does not increase the size of buildings e.g. alterations to external appearance;
- householder development, e.g. sheds, garages, games rooms etc., within the curtilage of the existing dwelling, in addition to physical extensions to the existing dwelling itself. This definition excludes any proposed development that would create a separate dwelling within the curtilage of the existing dwelling e.g. subdivision of houses into flats.

Furthermore section 18 of the Planning Practice Guidance for Flood Risk and Coastal Change looks at whether minor developments likely to raise flood risk issues? It states:

Minor developments are unlikely to raise significant flood risk issues unless:

- they would have an adverse effect on a watercourse, floodplain or its flood defences;
- they would impede access to flood defence and management facilities, or;
- where the cumulative impact of such developments would have a significant effect on local flood storage capacity or flood flows.

The Environment Agency's advice on flood risk assessments is helpful for ensuring extensions or alterations are designed and constructed to conform to any flood protection already incorporated within the property and include flood resilience measures in the design.

The Environment Agency's advice for minor developments for household extensions is to ensure floor levels are either no lower than existing floor levels or 300 millimetres (mm) above the estimated flood level.

3 Summary of Site Characteristics and Development Proposals

The proposals are for a single storey rear and side extension to existing dwelling at 62 Breakspear Road South, Ickenham, UB10 8HE, grid reference TQ 06935 86626.

The site is a brownfield / developed plot. The approximate area of the site is 420m², of which 215m² is covered by impermeable surfaces such as hardstanding and roofing. The proposals are classified as minor development in the context of Planning Policy Guidance.

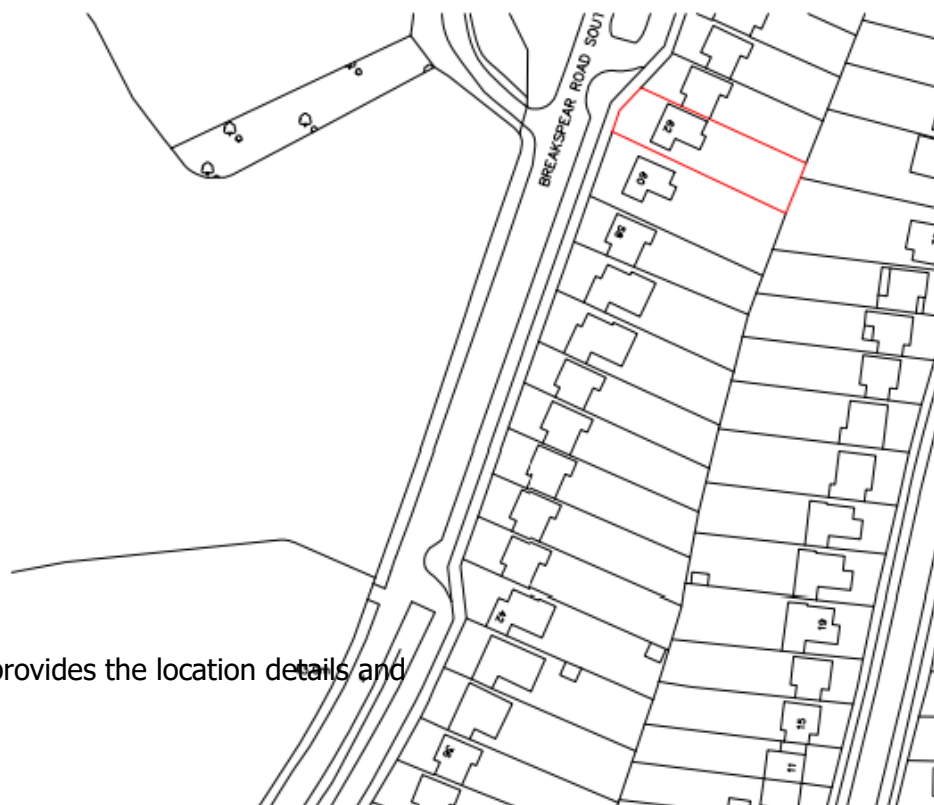


Figure 1 provides the location details and

Figure 2 shows an aerial photograph of the development site.

Figure 1 - Detailed location plan of the development site, highlighted.

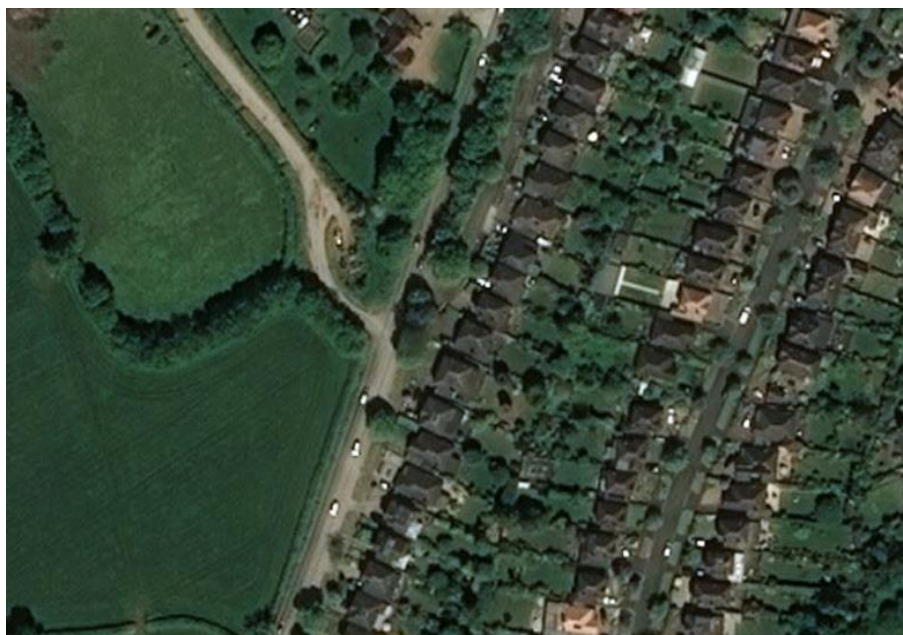


Figure 4 as existing.

Figure 3 - Proposed ground floor plan.

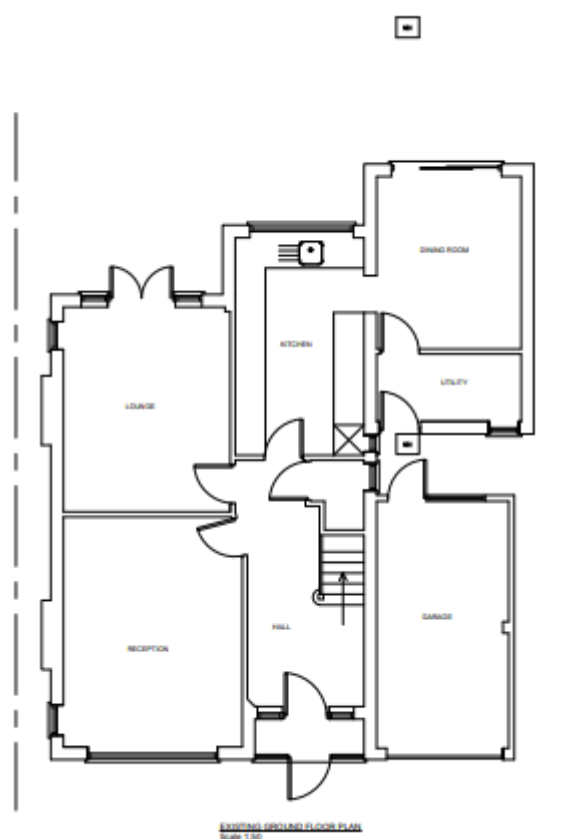


Figure 4 - Existing ground floor plan.

The development will result in a negligible increase in impermeable area, and there will be an increase in overall footprint of 45m².

Residential dwellings are classified as More Vulnerable development within *Table 2 - Flood Risk Vulnerability Classification* of the Planning Practice Guidance.

4 Sources of flooding

4.1 Fluvial/Tidal

The Environment Agency's Flood Map for Planning (Rivers and Sea) identifies fluvial and tidal flood zones and provides an indication of whether these zones are protected, due to the presence of flood defences. *Figure 5*, below, presents the Flood Map for the surrounding area and identifies the development site to lie within Flood Zone 1, and having a less than 1 in 1000 annual probability of river flooding.

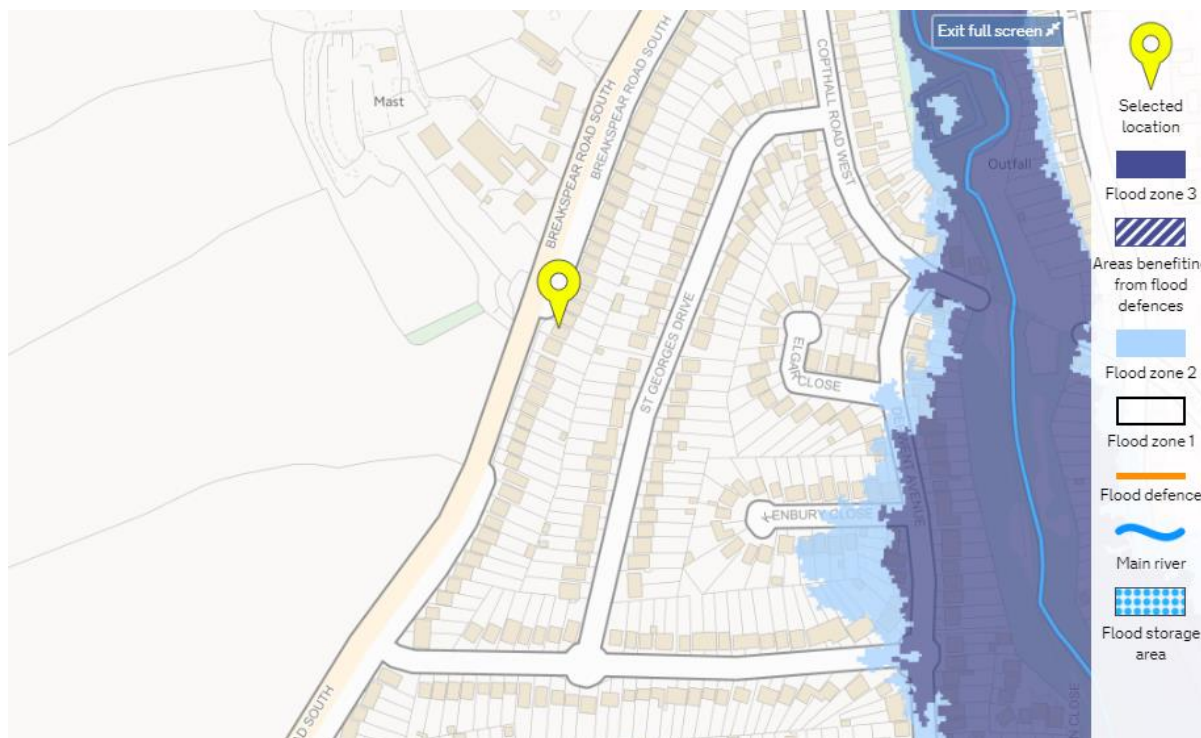


Figure 5 - Flood Map for Planning (Rivers and Sea).

4.2 Surface Water

The Environment Agency's updated Flood Map for Surface Water (uFMfSW) identifies pluvial flood risk. *Figure 6*, below, presents the surface water flood map for the development site and the surrounding area.

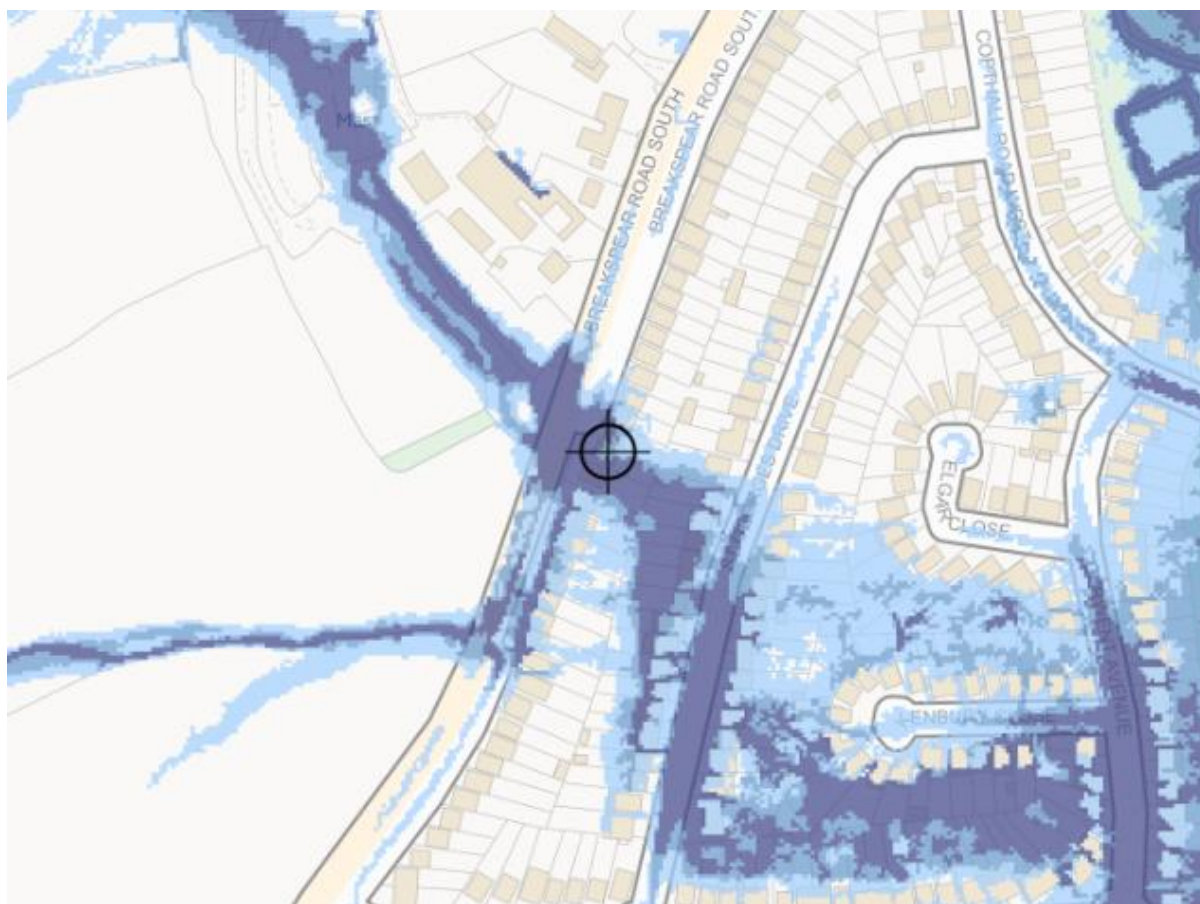
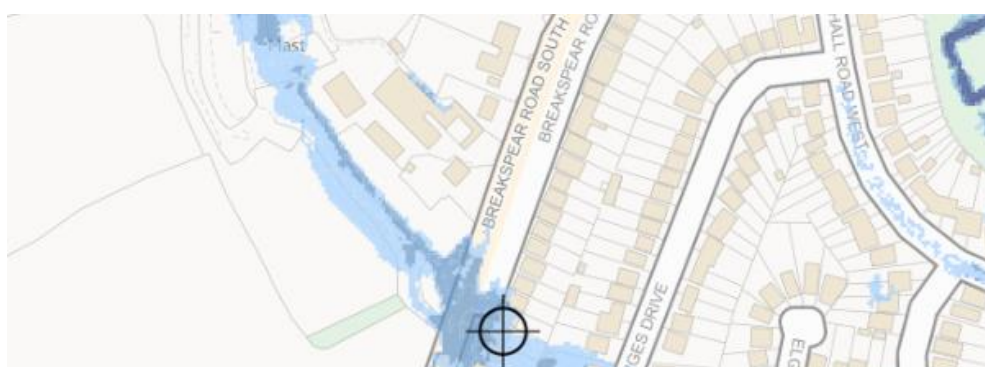


Figure 6 - Flood Map for Surface Water.

The surface water flood map shows that area in the vicinity of the development site is at High risk of surface water flooding. High risk means that the probability of flooding in any given year is greater than 3.3%.

Further analysis, as shown in

Figure 7 suggests there will be flooding between 300mm and 900mm to the property in the High risk scenario, and flooding between 300mm and 900mm in the Medium risk scenario.



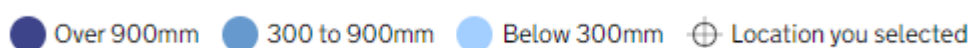


Figure 7 - Surface water flood depths.

Considering the impact of surface water velocity on the access / regress of the site, *Figure 8* shows velocities of over 0.25m/s in the High risk scenario and over 0.25m/s in the Medium risk scenario.

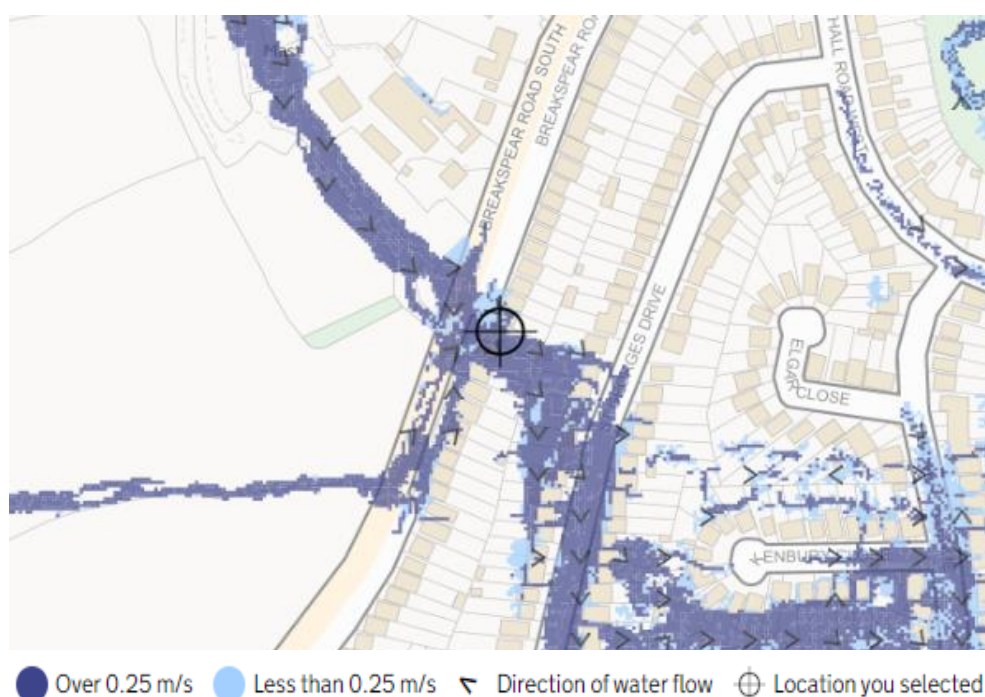


Figure 8 - Surface water velocities.

4.3 Reservoir

The development is not at risk from reservoir flooding.

4.4 Groundwater

The Environment Agency's Groundwater Vulnerability Map indicates that the development site is situated over a Medium vulnerability area, as shown in

Figure 9.

Further analysis shows that the development site is not situated over a Groundwater Source Protection Zone.

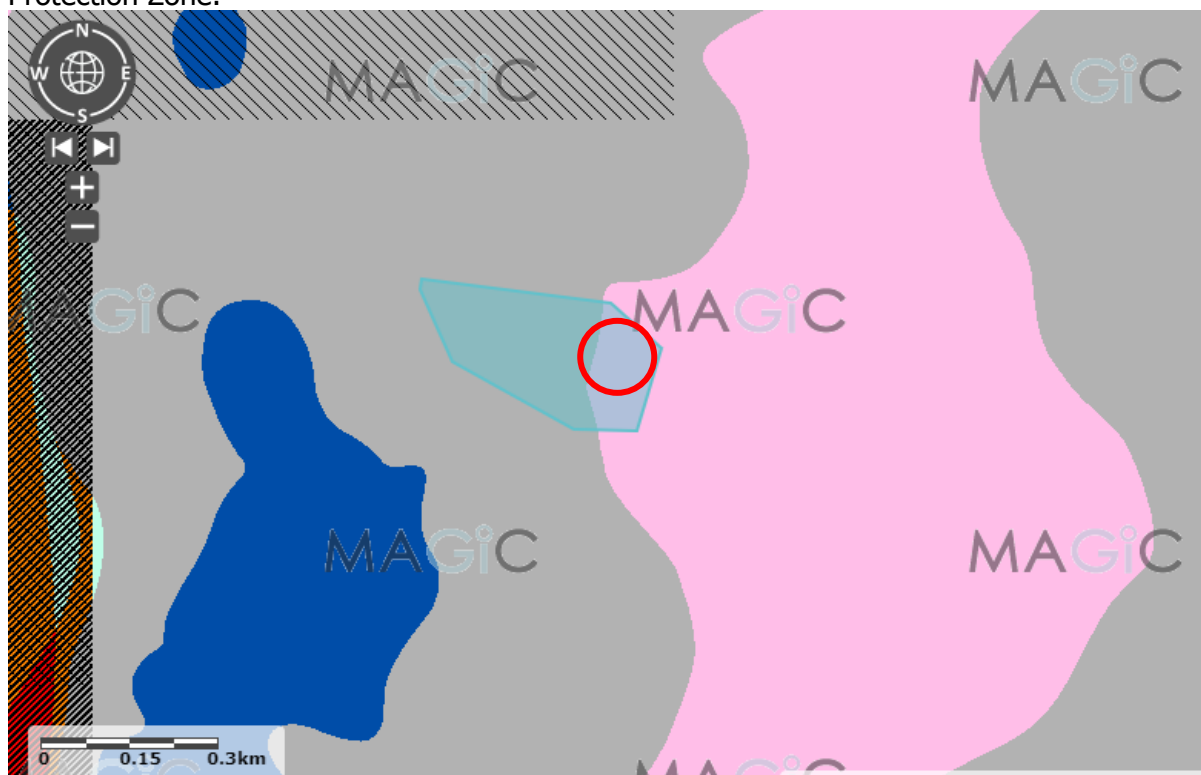


Figure 9 - Groundwater Vulnerability Map, site location highlighted.

Due to the minimal groundworks (for the construction of shallow foundations) the impact on groundwater is expected to be negligible.

4.5 Flood history

A review of strategic flood risk documents has not identified there to be a history of flooding on the site.

5 Surface Water Drainage

The existing runoff rate for the site has been calculated using the Modified Rational Rainfall Method given the site is already developed. Table 4 details the approach to estimating the existing runoff rate.

Table 4 - Existing Runoff Calculation

Modified Rational Rainfall Method		
where $Q = 2.78 * C_v * C_r * R_i * A$		
$C_v =$	0.75	fully impermeable areas, e.g. roads and hardstanding
$C_r =$	1.3	Routing Coefficient (CIRIA C697 recommends a value of 1.3)
$R_i =$	120 mm	rainfall intensity
$A =$	0.042 ha	current impermeable area
$Q =$	13.66 l/s	

At present the site drains via the public sewerage system (assumed) at $Q = 13.66\text{l/s}$.

6 Hierarchy of disposing surface water

The Planning Practice Guidance and part H of the Building Regulations state that “generally, the aim should be to discharge surface run off as high up the following hierarchy of drainage options as reasonably practicable:

- into the ground (infiltration);
- to a surface water body;
- to a surface water sewer, highway drain, or another drainage system;
- to a combined sewer”.

6.1 Infiltration

Records from the British Geological Survey have been reviewed to understand the geology of the area. These show that the site is underlain by Lambeth Group consisting of clay, silt and sand. Such soils may be suitable for infiltration.

6.2 Surface Water Body

There are no accessible watercourses within the immediate vicinity of the development.

6.3 Surface Water or Combined Sewer

There is a public sewerage system available and it is proposed that surface water is discharged to this system with separate connections to the foul and surface water systems, where available, if the LPA do not insist on the additional roof drainage being taken to a soakaway.

7 Use of SuDS

The NPPF, Planning Practice Guide and the Ministerial Statement promote the use of SuDS as a priority to aid the disposal of surface water from new developments.

Considering the suite of available SUDS measures and their suitability for use on this site, the following measures, or combination of, are recommended to minimise surface water runoff from the site: Permeable paving (source control); rain garden (source control).

The table below provides a maintenance schedule for the SuDS recommended.

Table 5 - recommended surface water maintenance schedule

SuDS Feature	Maintenance schedule	Requirement	Frequency	Responsibility
Waterbutts	Regular maintenance	Clearing of tank, inlets, outlets, gutters, withdrawal devices and roof drain filters and other debris	Annual (or following poor performance)	Landowner
	Occasional maintenance	Replacement of any filters	As required	Landowner
	Remedial actions	Repair any erosion damage, or damage to tank	As required	Landowner
	Monitoring	Inspection of tank for debris and sediment build up	Annual (or following poor performance)	Landowner
		Inspection of inlets, outlets and withdrawal devices	Annual (or following poor performance)	Landowner
		Inspection of areas receiving overflow, for evidence of erosion	After extreme storms	Landowner
Permeable paving	Regular maintenance	Inspection of roof drain filters	Annual (or following poor performance)	Landowner
		Brushing and vacuuming	Three times/year at end of winter, mid-summer, after autumn leaf fall - or as required	Landowner
	Occasional maintenance	Removal of weeds	As required	Landowner
	Remedial actions	Remedial work to any depressions, rutting and cracked or broken blocks considered detrimental to the structural performance or a hazard to users	As required	Landowner
		Rehabilitation of surface and upper surface sub-structure	As required	Landowner
	Monitoring	Initial inspection	Monthly for three months after installation	Landowner
		Inspect for evidence of poor operation and/or weed growth. If required take remedial action.	3-monthly, 48 hour after large storms	Landowner
		Inspect silt accumulation rates and establish brushing frequencies	Annually	Landowner
		Monitor inspection chambers	Annually	Landowner
	Regular maintenance	Clearing of inlets, outlets, gutters, withdrawal devices and roof drain filters and other debris. Ensure grass is cut on and around feature	Annual (or following poor performance)	Landowner
Soakaway	Occasional maintenance	Protect grass surface from compaction and siltation and manage main area of basin for design function or appearance.	As required	Landowner
	Remedial actions	Replace stones / granular fill in soakaway	As required	Landowner
	Monitoring	Inspection of feature (when required and if suspecting poor performance)	Annual (or following poor performance)	Landowner

8 Management of flood risk

8.1 Critical / design flood

The analysis of flood risk from fluvial and tidal sources shows that the site is within Flood Zone 1, and having a less than 1 in 1000 annual probability of river flooding.

A review of strategic flood risk documents has not identified there to be a history of flooding on the site.

Surface water flood risk information shows that there will be flooding between 300mm and 900mm to the property in the High risk scenario, and flooding between 300mm and 900mm in the Medium risk scenario (1 in 100 year annual probability).

The critical design flood depth to be managed is 900mm.

The finished floor level of the extension should be set no lower than existing.

8.2 Surface water runoff

The development will result in a negligible increase in impermeable area, therefore, no attenuation storage is required although SuDS have been considered to better manage surface water discharges.

There is a public sewerage system available and it is proposed that surface water is discharged to this system with separate connections to the foul and surface water systems, where available, if the LPA do not insist on the new roof drainage being taken to a soakaway.

Considering the suite of available SUDS measures and their suitability for use on this site, the following measures, or combination of, are recommended to minimise surface water runoff from the site: Permeable paving (source control); rain garden (source control).

As such, the proposed development will not increase the risk of flooding elsewhere from surface water sources.

8.3 Flood Resistance and Resilience Measures

Considering the flood risk to the development alongside best practice guidance for flood resilient design, 'Improving the Flood Performance of New Buildings' (CLG, 2007), the following recommendations are made. It should be noted that this is not an exhaustive list and variabilities in products may affect resilience performance:

Materials

Denser materials such as concrete and engineering bricks have good resilience characteristics. Table 6.1 (CLG,2007) document presents the characteristics of common building materials, tested in the laboratory, classified as having good, medium or poor performance with regard to water penetration, drying ability and integrity.

Definitions of the characteristics used in Table 6.1 are:

- water penetration – the seepage (rate and volume) through the material (note that this is different from “water absorption”)
- drying ability – the capability to regain its original moisture condition (assessed by the average drying rate and the time taken to reach the original value)
- retention of pre-flood dimensions, integrity – the lack of deformation or change in form or appearance of the material.

Table 6.1 Flood resilience characteristics of building materials (based on laboratory testing)			
Material	Resilience characteristics*		
	Water penetration	Drying ability	Retention of pre-flood dimensions, integrity
Bricks			
Engineering bricks (Classes A and B)	Good	Good	Good
Facing bricks (pressed)	Medium	Medium	Good
Facing bricks (handmade)	Poor	Poor	Poor
Blocks			
Concrete (3.5N, 7N)	Poor	Medium	Good
Aircrete	Medium	Poor	Good
Timber board			
OSB2, 11mm thick	Medium	Poor	Poor
OSB3, 18mm thick	Medium	Poor	Poor
Gypsum plasterboard			
Gypsum Plasterboard, 9mm thick	Poor	Not assessed	Poor
Mortars			
Below d.p.c. 1:3(cement:sand)	Good	Good	Good
Above d.p.c. 1:6(cement:sand)	Good	Good	Good
* Resilience characteristics are related to the testing carried out and exclude aspects such as ability to withstand freeze/thaw cycles, cleanability and mould growth			

Materials which meet the medium and good criteria of table 6.1 should be incorporated into the development.

Foundations

Foundations are designed to suit site conditions, namely the local geotechnical characteristics and the building design. Strip and trench-fill foundations are generally used where no special problems are identified, whereas raft, pile, pier and beam foundations may be necessary in other cases. In general, the choice of foundation type will be dictated by ground conditions, rather than resilience considerations. However, improvements can be made to increase the resilience.

For buildings up to two-storey, typically shallow footings are likely to be appropriate in most cases. It is common practice to use concrete blocks as substructure elements in typical cavity wall buildings but laboratory work has shown that groundwater can penetrate through the blocks into the wall cavity (and from there into the building) if care is not taken to minimise the passage of water. There is a general recommendation in the NHBC Standards (2006) to allow a clear cavity of at least 225mm below the damp proof course to prevent the build-up of any mortar dropped during construction from having a detrimental effect on the

performance of the wall. However, this unsealed void may be an entry point for rising groundwater into the property via the blockwork.

Walls

Table 6.1 (CLG,2007) presents the flood resilience characteristics of walls.

Table 6.2 Flood resilience characteristics of walls (based on laboratory testing)			
Material	Resilience characteristics*		
	Water penetration	Drying Ability	Retention of pre-flood dimensions, integrity
External face			
Engineering bricks (Classes A and B)	Good	Good	Good
Facing bricks (pressed)	Medium	Medium	Good
Internal face			
Concrete blocks	Poor	Medium	Good
Aircrete	Medium	Poor	Good
Cavity insulation			
Mineral fibre	Poor	Poor	Poor
Blown-in expanded mica	Poor	Poor	Poor
Rigid PU foam	Medium	Medium	Good
Render/Plaster			
Cement render – external	Good	Good	Good
Cement/lime render – external	Good	Good	Good
Gypsum Plasterboard	Poor	Not assessed	Poor
Lime plaster (young)	Poor	Not assessed	Poor
* Resilience characteristics are related to the testing carried out and exclude aspects such as ability to withstand freeze/thaw cycles, cleanability and mould growth			

Masonry walls:

Mortar joints should be thoroughly filled to reduce the risk of water penetration. If frogged bricks are used, they should be laid frog up so that filling becomes easier and coverage more certain. Bricks manufactured with perforations should not be used for flood resilient design.

Where possible, engineering bricks should be used up to predicted flood level plus one course of bricks to provide freeboard (up to maximum of 0.6m depth above floor level) to increase resistance to water penetration. Blocks (and dense facing bricks) have much improved performance when rendered.

Aircrete blocks allow less leakage than typical concrete blocks but concrete blocks dry more quickly.

The design of blockwork walls needs to consider these two opposite types of behaviour and consider whether drying or resistance to water is most relevant in each situation. For a “water exclusion strategy”, the expected amount of leakage is minimal and, therefore, Aircrete blocks are recommended, although they may retain moisture for longer than concrete blocks.

Compared with heavier blocks, Aircrete may offer less restraint to floor/slab edges which under the action of uplift forces could promote the opening of floor/wall junctions.

Highly porous bricks such as handmade clay bricks are inappropriate for use. Solid masonry walls are preferable but require internal or external wall insulation in order to comply with Building Regulations.

Clear cavity walls, i.e. with no insulation in the cavity, have better flood resilience characteristics than filled or part filled cavity walls as they dry more quickly. The requirements for insulation can be satisfied by external insulated renders or internal thermal boards.

There is evidence that thin layer mortar construction / thin joint is a good flood resilience option.

Framed walls:

Timber framed walls containing construction materials that have poor performance in floods should be avoided, e.g. oriented strand board and mineral fibre insulation. Timber framed walls are not recommended in a "water exclusion strategy". Steel framed walls may offer a suitable alternative option, but specialist advice needs to be sought on how to incorporate resilient materials/construction methods in the design, in particular with regard to the insulation.

Reinforced concrete wall/floor:

Construction should be considered for flood-prone areas, i.e. where the frequency of flooding is predicted to be high (see Chapter 4). This form of construction is effective at resisting forces generated by floodwater and will provide an adequate barrier to water ingress (provided service ducts and other openings into the building are adequately sealed).

External renders are effective barriers to water penetration and should be used with blocks (or bricks) at least up to the predicted flood level plus the equivalent of a course of bricks as freeboard. Structural checks may be necessary to ensure stability, because of the external water pressures that could occur for design flood depths above 0.3m. External cement renders with lime content (in addition to cement) can induce faster surface drying.

Insulation:

External insulation is better than cavity insulation because it is easily replaced if necessary.

Cavity insulation should preferably incorporate rigid closed cell materials as these retain integrity and have low moisture take-up. Other common types, such as mineral fibre batts, are not generally recommended as they can remain wet several months after exposure to flood water which slows down the wall drying process. Blown-in insulation can slump due to excessive moisture uptake, and some types can retain high levels of moisture for long periods of time (under natural drying conditions).

Internal linings:

Internal cement renders (with good bond) are effective at reducing flood water leakage into a building and assist rapid drying of the internal surface of the wall. The extent to which render prevents drying of other parts of the wall is not currently clear. This may be important, particularly for solid wall construction. This applies also to external renders.

Standard gypsum plasterboard should be avoided as it tends to disintegrate when immersed in water. Splash proof boards do not necessarily offer protection against flood waters, which may remain for some time and exert pressure on the board.

Given the flood risk to the development, it is proposed that the walls are constructed to prevent the ingress of water. Therefore, it is proposed that options with a medium or good option as detailed in Table 6.2 are implemented. As the predicted flood depths are up to 900mm it is recommended that all flood resilience measures should be incorporated to at least 900mm above ground level.

Doors and Windows

Sealed PVC external framed doors should be used and, where the use of wooden doors is a preferred option, all effort should be made to ensure a good fit and seal to their frames.

It may be necessary to replace the doors after a flood.

Windows/patio doors:

Windows and patio doors are vulnerable to flood water and similar measures to those used for doors should be taken. Special care should property. Double glazing which conforms to the relevant standards should in principle adequately resist the pressures generated by flood waters, although debris carried by flows may cause damage.

Air vents

Special designs of air vent are available in the market to prevent water ingress in circumstances. Careful consideration should be given to effectively sealing any associated joints.

Fittings

Durable fittings that are not significantly affected by water and can be easily cleaned should be used. The cost of these units may need to be balanced against the predicted frequency of flooding.

Place fittings (e.g. electrical appliances) should be placed on plinths as high as practicable, out of reach of flood water.

Joints between units and surfaces should be sealed to prevent any penetration of water behind fittings.

Services

Where possible, all service entries should be sealed (e.g. with expanding foam or similar closed cell material).

Closed cell insulation to be used for pipes that are below the predicted flood level.

Non-return valves are recommended in the drainage system to prevent the backflow of diluted sewage. Maintenance of these valves is important to ensure their continued effectiveness.

Water, electricity and gas meters should be located above predicted flood level.

Electrical sockets should be installed above flood level for ground floors to minimise damage to electrical services and allow speedy re-occupation. Electric ring mains should be installed at first floor level with drops to ground floor sockets and switches.

Boiler units and ancillary devices should be installed above the predicted flood level and preferably on the first floor of two-storey properties. Underfloor heating should be avoided on ground floors and controls such as thermostats should be placed above flood level. Conventional heating systems involving hot water pipes are unlikely to be significantly affected by flood water unless it contains a large amount of salts. The less common, hot air duct heating would remain effective provided it is installed above the design flood level.

Wiring for telephone, TV, Internet and other services should be protected by suitable insulation in the distribution ducts to prevent damage. Any proposed design solution for flood insulation on all potentially vulnerable wiring should be discussed with the relevant service providers.

9 Conclusions

The development is situated in Flood Zone 1; More Vulnerable developments are appropriate in Flood Zone 1.

In terms of surface water, there will be flooding between 300mm and 900mm to the property in the High risk scenario, and flooding between 300mm and 900mm to the property in the Medium risk scenario.

The critical design flood depth to be managed is 900mm.

The finished floor level of the extension should be set no lower than existing.

The development will result in a negligible increase in impermeable area, therefore, no attenuation storage is required although SuDS have been considered to better manage surface water discharges.

There is a public sewerage system available and it is proposed that surface water is discharged to this system with separate connections to the foul and surface water systems, where available.

Considering the suite of available SUDS measures and their suitability for use on this site, the following measures, or combination of, are recommended to minimise surface water runoff from the site: Permeable paving (source control); rain garden (source control).

As such, the proposed development will not increase the risk of flooding elsewhere from surface water sources.

Based on the likely flooding risk, it is considered that the proposed development can be operated safely in flood risk terms, without increasing flood risk elsewhere and is therefore appropriate development in accordance with the NPPF.