2. Applicant's FRA

AMBIENTAL

ENVIRONMENTAL ASSESSMENT

Flood Risk Assessment
4373

Land South of Wick House,

East End,

Fairford,

Gloucestershire,

GL7 4AP

Ambiental Environmental Assessment
Sussex Innovation Centre,
Science Park Square,
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Document Issue Record

Project: Phase 1 Flood Risk Assessment

Prepared for: SF Planning Limited on behalf of David George

Reference: 4373

Site Location: Land South of Wick House, East End, Fairford, Gloucestershire, GL7 4AP

Proposed Development: It is understood that the proposed development is for the construction of two residential dwellings on site with associated landscaping and access arrangements.

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Contents

1. Summary

1.1 Ambiental Environmental Assessment has been appointed by SF Planning on behalf of David George to undertake a National Planning Policy Framework (NPPF) compliant Flood Risk Assessment (FRA) for the proposed development at Land South of Wick House, East End, Fairford, Gloucestershire, GL7 4AP.

1.2 The existing site currently contains unkept tennis courts which have an existing hardstanding surface area of approximately 427m^2. It is understood that the proposed development is for the construction of two residential dwellings on site with associated landscaping and access arrangements.

1.3 With reference to the Environment Agency (EA) Flood Map for Planning, the proposed development is located within Flood Zones 1, 2 and 3. The two proposed dwellings lie entirely within Flood Zone 1, whilst approximately 43m^2 and 16m^2 of the wider site area is located within Flood Zone 2 and 3 respectively. The existing site currently contains unkept tennis courts and as such is considered as 'Less Vulnerable' under the NPPF. Given that the proposed development is for residential use, post-development the site will be considered 'More Vulnerable' under the NPPF albeit the areas within Flood Zones 2/3 would be garden areas to the proposed residential units.

1.4 Based on plans provided by the client, the southern proposed dwelling will have a bedroom at ground floor level. The northern proposed building will have all sleeping accommodation at first floor level.

1.5 Following an assessment of 1m LiDAR data, elevations on site vary between approximately 83.06mAOD and 83.41mAOD. Topographic levels indicate that the site generally slopes to the south-east towards the River Coln (located approximately 330m south).

1.6 Ambiental had subsequently requested site-specific detailed model data from the Environment Agency (EA). The EA have stated that:

"Your site lies in Flood Zone 1 and we therefore do not have any detailed flood risk modelling in this location. We have modelled the River Thames in the area but the modelled extents do not cover the site"

1.7 The EA modelled flood extents can be found in Appendix III of this report. It can be seen that the site is located outside the modelled 1:100 year +CC (20%) and 1:1000 year flood extents.

1.8 As such, Ambiental have utilised in-house "Flowroute" software to determine water levels for the 100 year, 100 year +35% increase in flows (to account for climate change), 100 year +70% increase in flows and the 1000 year design events. **Modelled flood levels extracted from the Flowroute products show the development to lie outside of the 100yr, 100yr +35%, 100yr +70% and the 1000yr flood extent.**

1.9 The proposed residential dwellings could therefore be considered to be safe for their lifetime (classified under the NPPF to be 100 years whilst also accounting for climate change) without increasing flood risk elsewhere.

1.10 The Cotswold District Council SFRA (2008) states that SuDS should be implemented to ensure that runoff from the site (post development) is reduced. Where prevention, source control/infiltration cannot deal with all on-site site drainage, for both Greenfield and Brownfield sites, the development runoff volumes and peak flow rates leaving the site should be attenuated to the Greenfield discharge conditions. Initial soakaway storage calculations have been undertaken as part of this Flood Risk Assessment. These should be confirmed at detailed design stage.

1.11 As such, and given that:

- the proposed development is for the construction of two residential dwellings;
- as existing, 427m^2 of the site is already occupied by hardstanding surfaces in the form of tennis courts;
- modelled flood extents from in-house Flowroute simulations show the proposed dwellings to lie outside of the 100yr, 100yr +35%CC, 100yr +70%CC and the 1000yr flood extent;
- under the NPPF, the proposed dwellings can be considered safe for their lifetime without increasing flood risk elsewhere;
- in terms of flood vulnerability, significant betterment can be achieved through the implementation of flood warning procedures as the site lies within an EA Flood Warning Service Area, and as such prior evacuation can be sought.

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:	Unkept tennis courts	Two residential dwellings
Number of Bedrooms:	N/A[1]	Both dwellings are proposed to have four bedrooms
EA Vulnerability Classification:	Less Vulnerable	More Vulnerable
Ground Floor Level:	Elevations on site vary between approximately 83.06mAOD and 83.41mAOD (1m LiDAR data).	No change
Level of Sleeping Accommodation:	N/A[1]	Proposed northern dwelling to have sleeping accommodation set all at first floor level. Proposed southern dwelling to have one bedroom at ground floor.
Impermeable Surface Area:	N/A[1]	Increase
Surface Water Drainage:	N/A[1]	Roof areas to drain to soakaway. Permeable Paving should be used in place of impermeable hardstanding in external areas. Strategy to be refined at detailed design stage.
Site Size:	Approximately 1,610m^2 including access track. Development area with two dwelling approximately 697m^2	No change
Risk to Development	**Summary**	**Comment**
EA Flood Zone:	Flood Zones 1, 2 and 3	Dwellings to be in Flood Zone 1
Flood Source:	Fluvial and Pluvial	River Coln
1:100 Year Flood Level:	82.921mAOD	The site is located outside EA modelled 1:100 year +CC (20%) and 1:1000 year flood extents.
1:100 Year Flood Level +35% Climate Change:	82.933mAOD	As such, flood levels have been provided by Ambiental's in-house modelling software, 'Flowroute'.
1:100 Year Flood Level +70% Climate Change:	82.948mAOD	The 1:1000-year event has been provided as part of the UK FloodMap4 product. The 1:100-year, 1:100-year +35%CC and 1:100-year +70%CC have been provided as part of the FloodFutures product.
1:1000 Year Flood Level	N/A[1]	The difference in LiDAR imagery used between the two products explains how a flood level has been reported for the 1:100 year and not the 1:1000 year return period
Recorded Flood Events in Area:	Yes	EA have provided a historic fluvial and pluvial flood event from July 2007 which have affected the wider area
Recorded Flood Events at Site:	Yes	The historic pluvial flood event from July 2007 has been shown to affect the site. The site boundary lies outside of the fluvial event.
SFRA Available:	Yes	Cotswold District Council (2008)
Management Measures	**Summary**	**Comment**
Ground floor level above extreme flood levels:	Yes	Proposed dwellings outside 1:100 year +CC (35% and 70%) extents from Ambiental FloodFutures extent. Southern dwelling to be on land approximately 0.18m above 1:100 year +CC (35%) flood level
Safe Access/Egress Route:	Yes	Proposed development is located wholly in Flood Zone 1. The access track may experience depths of up to 300mm during the 1:1000-year pluvial event
Flood Resilient Design:	Yes	See Section 7 of this report
Site Drainage Plan:	N/A[1]	Roof areas to drain to soakaway. Permeable Paving should be used in place of impermeable hardstanding in external areas. Strategy to be refined at detailed design stage.
Flood Warning & Evacuation Plan:	Yes	EA Flood Alert/Flood Warning Service
Offsite Impacts	**Summary**	**Comment**
Displacement of floodwater:	None	Dwellings to be in Flood Zone 1
Increase in surface run-off generation:	None	Attenuate runoff from the site post-development in accordance with guidance outlined in the Cotswold District Council SFRA (2008)
Impact on hydraulic performance of channels:	None	Development will not affect channel

Table 1 Summary of flood risks, impacts and proposed flood mitigation measures
N/A[1] not required for this assessment; N/A[2] data not available

2. Development Description and Site Area

Proposed Development and Location

2.1 The proposed development is located on Land South of Wick House, East End, Fairford, Gloucestershire, GL7 4AP (*Figure 1*).

2.2 The existing site currently contains unkept tennis courts. It is understood that the proposed development is for the construction of two residential dwellings on site with associated landscaping and access arrangements.

2.3 Following the assessment of 1m LiDAR data, elevations on site vary between approximately 83.06mAOD and 83.41mAOD. Topographic levels indicate that the site and surrounding area generally slopes to the south-east towards the River Coln (located approximately 330m south).

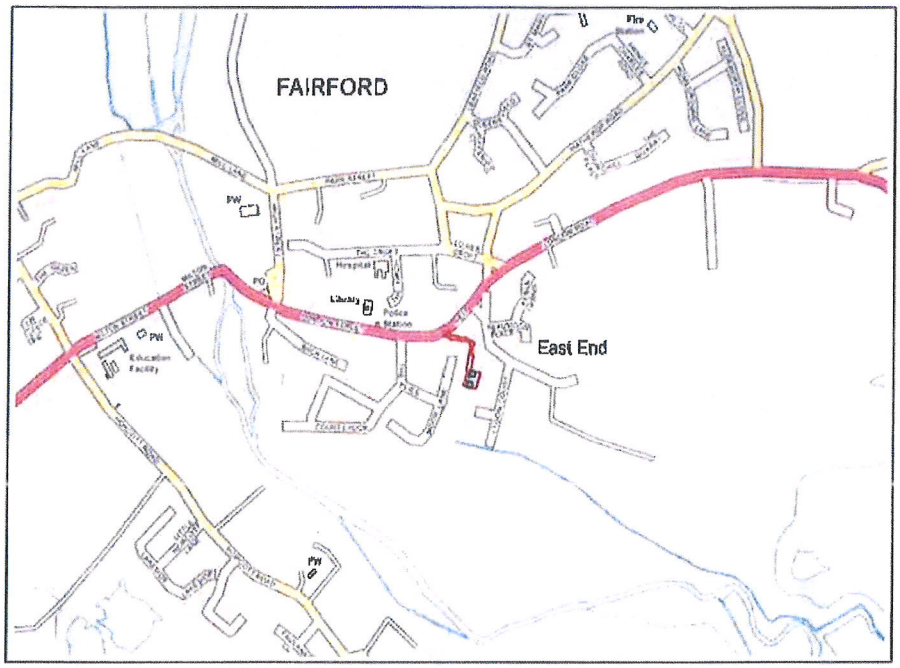

Figure 1 Location Map, identifying the location of the proposed development (Source: OS)

Vulnerability Classification

2.4 The EA Flood Map for Planning demonstrates that the vast majority of the site, including the whole of the two proposed dwellings, to lie within Fluvial Flood Zone 1 (less than a 1 in 1000 (0.1%) annual chance of river flooding). However approximately 43m^2 and 16m^2 of the wider site area is located within Flood Zone 2 (between a 1 in 1000 (0.1%) and 1 in 100 (1%) annual chance of river flooding) and Flood Zone 3 (greater than a 1 in 100 (1%) annual chance of river flooding) respectively.

2.5 The existing site currently contains unkept tennis courts and therefore, in accordance with NPPF guidelines, is classified as 'Less Vulnerable'. The site will be used for residential use post-development and as such the proposed development is classified as 'More Vulnerable'.

Figure 2 EA Flood Map for Planning

Geology

2.6 The British Geological Survey (BGS) Geology of Britain Viewer indicates that the underlying bedrock beneath the site is of the Cornbrash formation, comprising of limestone.

2.7 Superficial deposits have also been identified to lie beneath the surface. These have been identified to belong to the Northmoor Sand and Gravel Member by the BGS Geology of Britain Viewer.

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 NPPF *Sequential Test: 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 *Functional Floodplain*	Exception Test Required	✓	×	×	×

Table 2 The Sequential Test: 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 Although the redline boundary of the site is partially within Flood Zones 2 and 3, the proposed dwellings themselves are to be sequentially located on site to Flood Zone 1. As such, it could be considered that a sequential approach has already been adopted in the site layout.

3.4 Given that the wider redline boundary is located partly in Flood Zone 2 and 3, Ambiental requested site-specific detailed model data from the Environment Agency (EA). The EA have stated that:

"Your site lies in Flood Zone 1 and we therefore do not have any detailed flood risk modelling in this location. We have modelled the River Thames in the area but the modelled extents do not cover the site"

3.5 Within Appendix III of this report, it can be seen that the site is located outside the modelled 1:100 year +CC (20%) and 1:1000 year flood extents.

3.6 As such, the site is shown to be sequentially located inside Flood Zone 1 and there would subsequently be no requirement to pass either the Sequential or Exception Test.

3.7 In February 2016, the EA updated the projections for the influence of climate change from a nation-wide +20% increase in flows to varying increases depending on the River Basin that the site falls within. The proposed development is for the build of two residential dwellings in the Thames Basin and as such, in accordance with the latest guidance for climate change, it is to be required that an increase in flows of approximately +35% and +70% are considered.

3.8 As such, Ambiental have utilised in-house "Flowroute" software to determine water levels for the 100 year+35%CC and 100 year+70%CC design events. **Modelled flood levels extracted from the Flowroute products show the development to lie outside of the 100yr +35%CC and 100yr +70%CC flood extents.**

3.9 As such, the proposed development can be shown to be safe for its lifetime (accounting for climate change) without increasing Flood Risk elsewhere.

4. Site Flood Hazards

Sources of Flooding

4.1 The proposed development is located within Flood Zones 1, 2 and 3 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	River Coln and Unknown Drain
Surface	Low risk on site
Groundwater	In area
Sewer	In area

Table 3 Summary of flood sources.

Mechanisms and History of Flooding

4.2 The EA Flood Map for Planning demonstrates the vast majority of the site, including the whole of the two proposed dwellings, to lie within Fluvial Flood Zone 1 (less than a 1 in 1000 (0.1%) annual chance of river flooding). However approximately 43m^2 and 16m^2 of the wider site area is located within Flood Zone 2 (between a 1 in 1000 (0.1%) and 1 in 100 (1%) annual chance of river flooding) and Flood Zone 3 (greater than a 1 in 100 (1%) annual chance of river flooding) respectively.

4.3 It is important to note that the EA Flood Map for Planning shows only the potential floodplain; the mitigating effects of any flood defences currently in place are not considered.

Fluvial

4.4 The River Coln is located approximately 330m south of the development site and is classified as an EA Main River. The closest watercourse to the site however is a drain located approximated 105m south.

4.5 With regards to the EA Flood Map for Planning, the proposed development is located within Flood Zones 1 2 and 3 as displayed in *Figure 3*. The proposed residential dwellings are located wholly in Flood Zone 1.

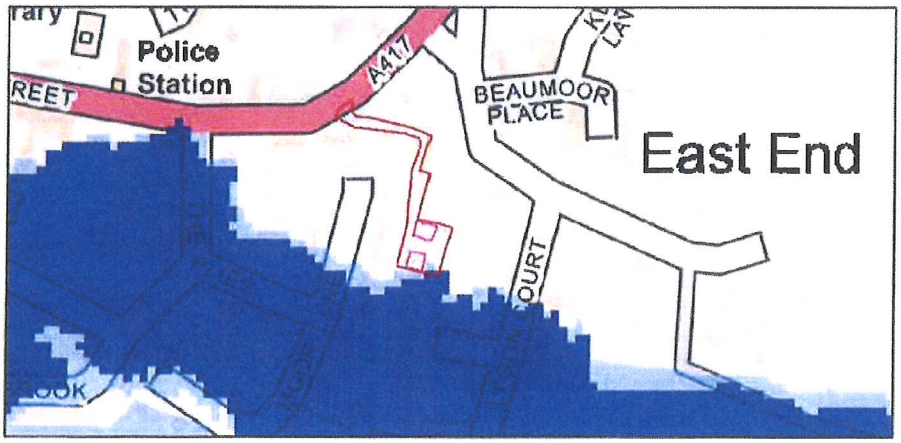

Figure 3 Wider site boundary (red polygon) is shown to lie in Flood Zones 1, 2 and 3. The dwellings lie wholly within FZ 1

4.6 Following review of topographic levels at the site, using 1m LiDAR data, topographic elevations were found to vary between approximately 83.06mAOD and 83.41mAOD (1m LiDAR data). Analysis of topographic levels indicates that the site generally slopes south-east, towards the River Coln.

4.7 Ambiental had subsequently requested site-specific detailed model data from the Environment Agency (EA). The EA have stated that:

"Your site lies in Flood Zone 1 and we therefore do not have any detailed flood risk modelling in this location. We have modelled the River Thames in the area but the modelled extents do not cover the site"

4.8 <u>The EA modelled flood extents can be found in Appendix III of this report. It can be seen that the site is located outside the modelled 1:100 year +CC (20%) and 1:1000 year flood extents.</u>

4.9 As such, Ambiental have utilised in-house "Flowroute" software to determine water levels for the 100 year, 100 year +35% increase in flows (to account for climate change), 100 year +70% increase in flows and the 1000 year design events. The 1:1000-year dataset has been produced as part of the UK FloodMap4 product which is modelled using a different LiDAR imagery from the 100 year and 100 year plus climate change simulations which are produced as part of a product known as FloodFutures.

4.10 As part of the UKFloodMap4 dataset, the 30yr simulation was ran (*Figure 4*). These outputs are most indicative of the functional floodplain given that the 20yr simulation has not been ran. By using the 30yr simulation, Ambiental are adopting a conservative approach to defining Flood Zone 3a and 3b, given that larger peak flows are used for the 30yr simulation and given that it is a larger storm event. The site is shown to lie well outside of the 30yr maximum flood extent and as such, the proposed development is not considered to be located within Flood Zone 3b.

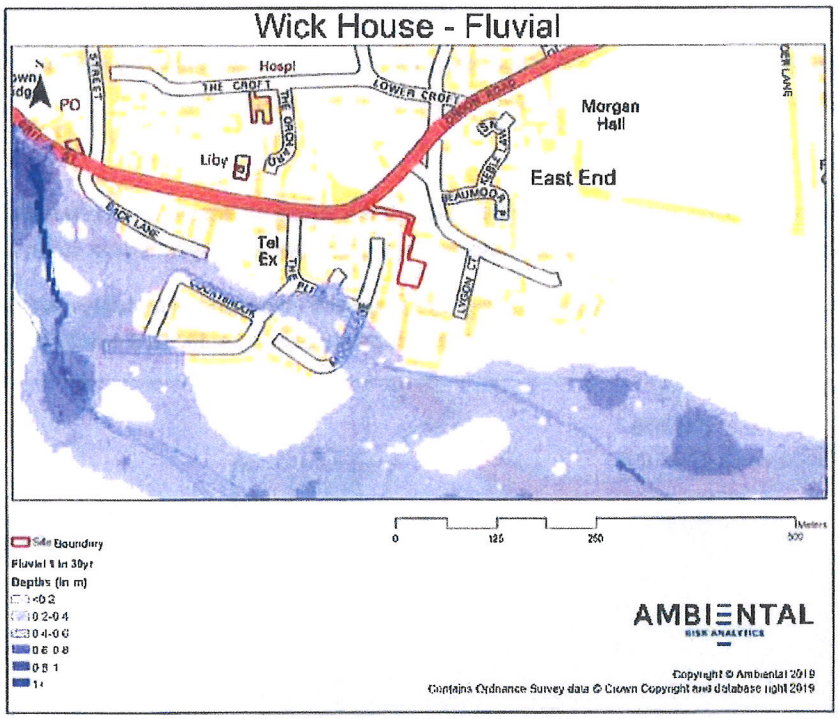

Figure 4 Flowroute 1 in 30 year flood extent which displays the redline site boundary to be located outside of the 1 in 30 year maximum flood extent and therefore outside of Flood Zone 3b.

4.11 Following review of the Flowroute 1 in 100 year model outputs, the entire redline site boundary is also shown to be located outside of the predicted maximum flood extent, as displayed in *Figure 5*. The image below also features the distribution of several 2D node points. No nodes have been provided within the redline site boundary given that these would all report a value of 0.

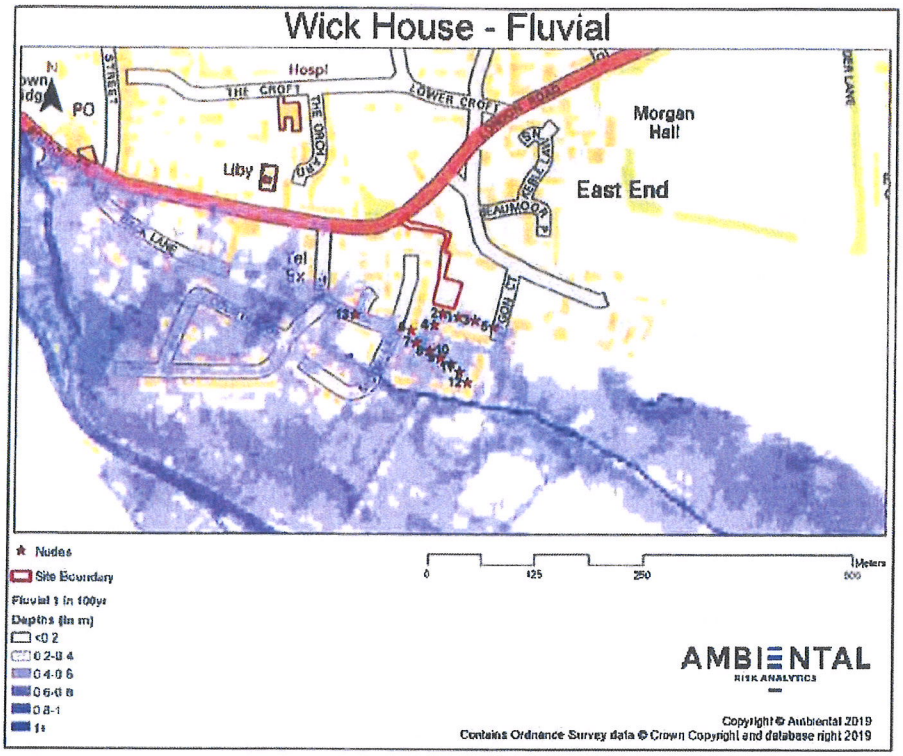

Figure 5 Flowroute 1 in 100 year flood extent which displays the redline site boundary to be located outside of the 1 in 100 year maximum flood extent.

4.12 The nearest 2D node to the redline site boundary is node number 2, which reports a depth of 17mm for the 1 in 100 year event. Depths are larger, yet are still small at node 1 where 66mm is reported for the 1 in 100 year event. Depths have been identified to be deepest along 'The Plies', 115m west of the site where node 13 reports depths of 225mm.

4.13 The proposed development is for the construction of two residential dwellings on site. As such, under the NPPF it is necessary to prove that the proposed development will be safe for its lifetime (assumed to be 100 years when also accounting for the projected impacts of climate change) whilst without increasing flood risk elsewhere.

4.14 The proposed development site lies within the Thames River Basin. Given that the redline site boundary lies marginally within Flood Zone 3a, the EA Climate Change Allowance Table recommend consideration of the Higher Central and Upper End peak river flow allowances. These equate to a projected increase in flows of +35% and +70% respectively for the Thames basin district. Given that the vast majority of the site, including the whole of the two proposed dwellings lie within Flood Zone 1 (with reference to the EA Flood Map for Planning), it could be considered onerous to consider the +70% flood level and as such any mitigation measures will be recommended in accordance with the +35% flood level. The maps displayed in *Figures 6 & 7* show the entire redline site boundary to be located outside of the modelled maximum flood extents for both of the 1 in 100 year +35%CC and 1 in 100 year +70%CC events.

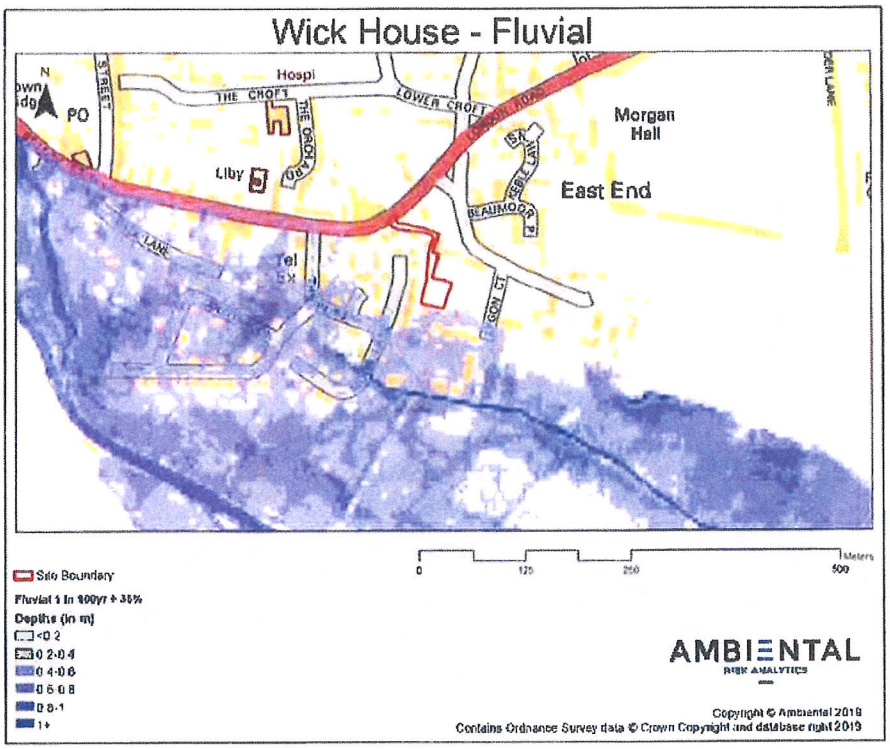

Figure 6 Flowroute 1 in 100 year +35%CC flood extent. The entire redline site boundary is shown to be located outside of the maximum flood extent.

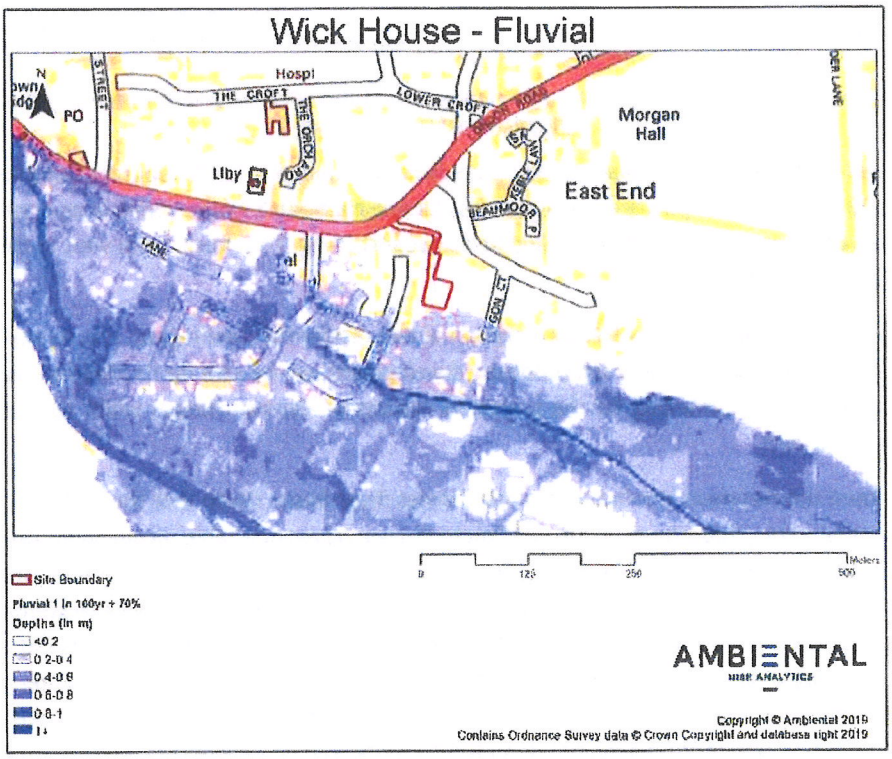

Figure 7 Flowroute 1 in 100 year +70%CC flood extent. The entire redline site boundary is shown to be located outside of the maximum flood extent.