

FloodSmart



Flood Risk Assessment

Site Address

Land north of Chiswell Green Lane
Chiswell Green
St Albans

Grid Reference

E 512832 N 204703

Report Prepared for

McPartland Planning
10 Orient Close
St Albans
Hertfordshire
AL1 1AJ

Date

2021-07-28

Report Status

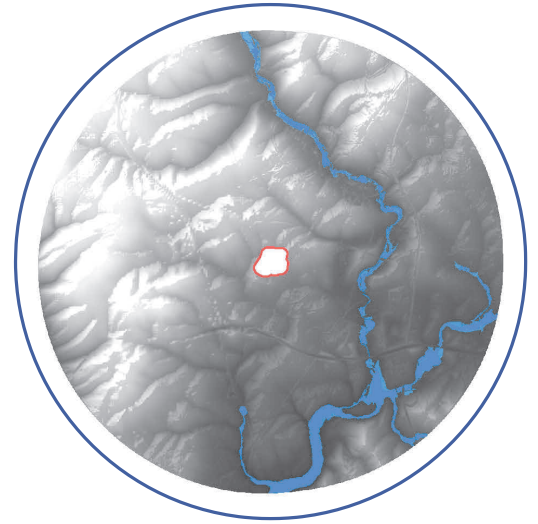
FINAL

Site Area

14.2 ha

Report Reference

75188R1



RISK – Very Low to High

The Site is located within fluvial Flood Zone 1 (Low probability), and within an area defined as being at Very Low risk. The Site has a Very Low to High risk of surface water flooding and a Negligible risk of groundwater flooding.

Report Author

Alexandra Pickles
Consultant

Report Checker & Reviewer

Alan White
Principal Consultant

GeoSmart Information Ltd
Suite 9-11, 1st Floor, Old Bank Buildings,
Bellstone, Shrewsbury, SY1 1HU
+44(0)1743 298 100
info@geosmartinfo.co.uk
www.geosmartinfo.co.uk

1. Executive summary



A review has been undertaken of national environmental data sets to assess the flood risk to the Site from all sources of flooding in accordance with The National Planning Policy Framework (NPPF) (2019) and National Planning Practice Guidance (NPPG) (2014). A site-specific flood risk assessment, to assess the flood risk to and from the development Site, is provided within this concise interpretative report written by an experienced GeoSmart consultant. Baseline flood risk and residual risks that remain after the flood risk management and mitigation measures are implemented are summarised in the table below.

Site analysis

Source of Flood Risk	Baseline	After Mitigation
River (fluvial) and Sea (coastal/tidal)	Very Low	N/A
Surface water (pluvial) flooding	Very Low to High	Very Low to Medium
Groundwater flooding	Negligible	N/A
Other flood risk factors present	Yes	Yes ¹
Is any other further work recommended?	Yes	Yes (see below)

N/A = mitigation not required

¹A risk has been identified from sewers, although the level of risk could not be determined.

Summary of existing and proposed development

The Site is currently used in an agricultural capacity for crop growth (micro-salad), cattle grazing and paddocks, and hay production, and has previously been used in a commercial capacity as a recreational sports ground for polo. A gravel track is on-Site to the south of the Site and four buildings are present, the largest being used for hay storage (drained via French drains and soakaway), a smaller shed used to grow micro salad, and two wooden stables used for hay storage. The Site has been confirmed to be 99 % greenfield in a report by Structural Soils in June 2021.

Development proposals are for the erection of 327 residential dwellings comprising of:

- 180 three-bed dwellings;
- 115 two-bed dwellings; and
- 32 one-bed dwellings.

Associated access road, garden and amenity, and parking are also proposed, with primary vehicular access to the Site from the south along Chiswell Green Lane. Pedestrian and cycling access are also proposed to the east along The Croft.

Summary of flood risks

The flood risks from all sources have been assessed as part of this report and are as follows:

According to the Environment Agency's (EA) Flood Map for Planning Purposes, the Site is located in a fluvial Flood Zone 1 (Low probability).

According to the EA's Risk of Flooding from Rivers and Sea (RoFRS) map, which considers the type, condition and crest height of flood defences, the Site has a Very Low risk of flooding from Rivers and the Sea.

According to the EA's Risk of Flooding from Surface Water (pluvial) flood mapping, the Site is at a variable risk of pluvial flooding ranging from Very Low to High.

Groundwater Flood Risk screening data indicates there is a Negligible risk of groundwater flooding at the surface in the vicinity of the Site during a 1 in 100 year event.

The risk of flooding from artificial (man-made) sources such as reservoirs, sewers and canals has been assessed:

- The EA's Risk of Flooding from Reservoir map confirms the Site is not at risk of reservoir flooding.
- Ordnance Survey (OS) data confirms there are no canals near to the Site.
- A sewer flooding history search was undertaken using the Strategic Flood Risk Assessment (JBA Consulting, 2014). Table 1-2 of Appendix A of the SFRA has identified 10 incidences or modelled incidences of flooding as a result of surcharging sewers within the AL2 3 postcode. However, it is recognised that this four digit postcode covers a large area and instances of flooding are not specific to the Site.

A risk has been identified from sewers, although the level of risk could not be determined.

The risk to the development has been assessed over its expected 100 year lifetime, including appropriate allowances for the impacts of climate change. More extreme weather events could increase the risk to the Site from increased potential for surface water. Site specific assessment indicates risk to the Site will not increase significantly and appropriate mitigation measures are proposed.

Recommendations / Next steps

Recommendations for mitigation are provided below, based upon the proposed development and the flood risk identified at the Site:

- As there is a risk of flooding from surface water (pluvial) sources, where flood depths could be up to 0.3 m in depth, Finished Floor Levels (FFL) of the proposed developments affected (five residential plots in the north western corner) should be set at least 0.3 m above surrounding ground levels and ground levels should aim to slope away from

buildings. Ground levels should be designed to channel any overland flows from off-Site away from the development and Site drainage systems;

- A surface water drainage strategy has been prepared separately (ref: 75188.01) to ensure surface water runoff can be managed effectively over the lifetime of the proposed development.

In addition, the regular maintenance of any drains and culverts surrounding/on the Site should be undertaken to reduce the flood risk.

GeoSmart recommend the mitigation measures discussed within this report are considered as part of the proposed development where possible and evidence of this is provided to the Local Planning Authority as part of the planning application.

2. Introduction



Background and purpose

A site-specific flood risk assessment has been undertaken, to assess the flood risk to and from the development Site. This assessment has been undertaken by firstly compiling information concerning the Site and the surrounding area. The information gathered was then used to construct a 'conceptual site model', including an understanding of the appropriateness of the development as defined in the NPPF (2019) and the source(s) of any flood risk present. Finally, a preliminary assessment of the steps that can be taken to manage any flood risk to the development was undertaken.

This report has been prepared with reference to the NPPF (2019) and NPPG (2014).

"The National Planning Policy Framework set out the Government's planning policies for England and how these are expected to be applied" (NPPF, 2019).

The NPPF (2019) and NPPG (2014) promote a sequential, risk based approach to the location of development. This also applies to locating a development within a Site which has a variable risk of flooding.

"This general approach is designed to ensure that areas at little or no risk of flooding from any source are developed in preference to areas at higher risk. The aim should be to keep development out of medium and high risk flood areas (Flood Zones 2 and 3) and other areas affected by other sources of flooding where possible" (NPPG, 2014).

The purpose of this report is to provide clear and pragmatic advice regarding the nature and potential significance of flood hazards which may be present at the Site.

Report scope

In accordance with the requirements set out within NPPG 2014 (Paragraph: 030 Reference ID: 7-030-20140306), a thorough review of a commercially available flood risk report and EA supplied data indicating potential sources of flood risk to the Site from rivers and coastal sources, surface run-off (pluvial), groundwater and reservoirs, including historical flood information and modelled flood extent. Appropriate measures are recommended to manage and mitigate the flood risk to the property.

Information obtained from the EA and a review of the South West Hertfordshire Level 1 Strategic Flood Risk Assessment (SFRA) (JBA Consulting, 2018) is used to ascertain local flooding issues and, where appropriate, identify information to support a Sequential and/or Exception test required as part of the NPPF (2019).

The existing and future flood risks to and from the Site from all flood sources is assessed in line with current best practice using the best available data. The risk to the development has been assessed over its expected lifetime, including appropriate allowances for the impacts of climate change. Residual risks that remain after the flood risk management and mitigation

measures are implemented, are considered with an explanation of how these risks can be managed to keep the users of the development safe over its lifetime.

An indication of whether the Site will potentially increase flood risk elsewhere is provided, including where the proposed development increases the building footprint at the Site. A drainage strategy to control runoff can be commissioned separately if identified as a requirement within this report.

Report limitations

It is noted that the findings presented in this report are based on a desk study of information supplied by third parties. Whilst we assume that all information is representative of past and present conditions, we can offer no guarantee as to its validity and a proportionate programme of site investigations would be required to fully verify these findings.

The basemap used is the OS Street View 1:10,000 scale, however the Site boundary has been drawn using BlueSky aerial imagery to ensure the correct extent and proportion of the Site is analysed.

This report excludes consideration of potential hazards arising from any activities at the Site other than normal use and occupancy for the intended land uses. Hazards associated with any other activities have not been assessed and must be subject to a specific risk assessment by the parties responsible for those activities.

Datasets

The following table shows the sources of information that have been consulted as part of this report:

Table 1. Datasets consulted to obtain confirmation of sources of flooding and risk

Source of flooding	Datasets consulted			
	Commercial Flood Maps	SFRA*	Environment Agency	OS Data
Historical	X	X	X	
Fluvial/tidal	X	X	X	
Surface water (pluvial)	X	X	X	
Groundwater	X	X		
Sewer		X		
Culvert/bridges		X		X
Reservoir		X	X	

*The SFRA and local guidance have been used to inform this report as referenced in Section 6.

3. Site analysis

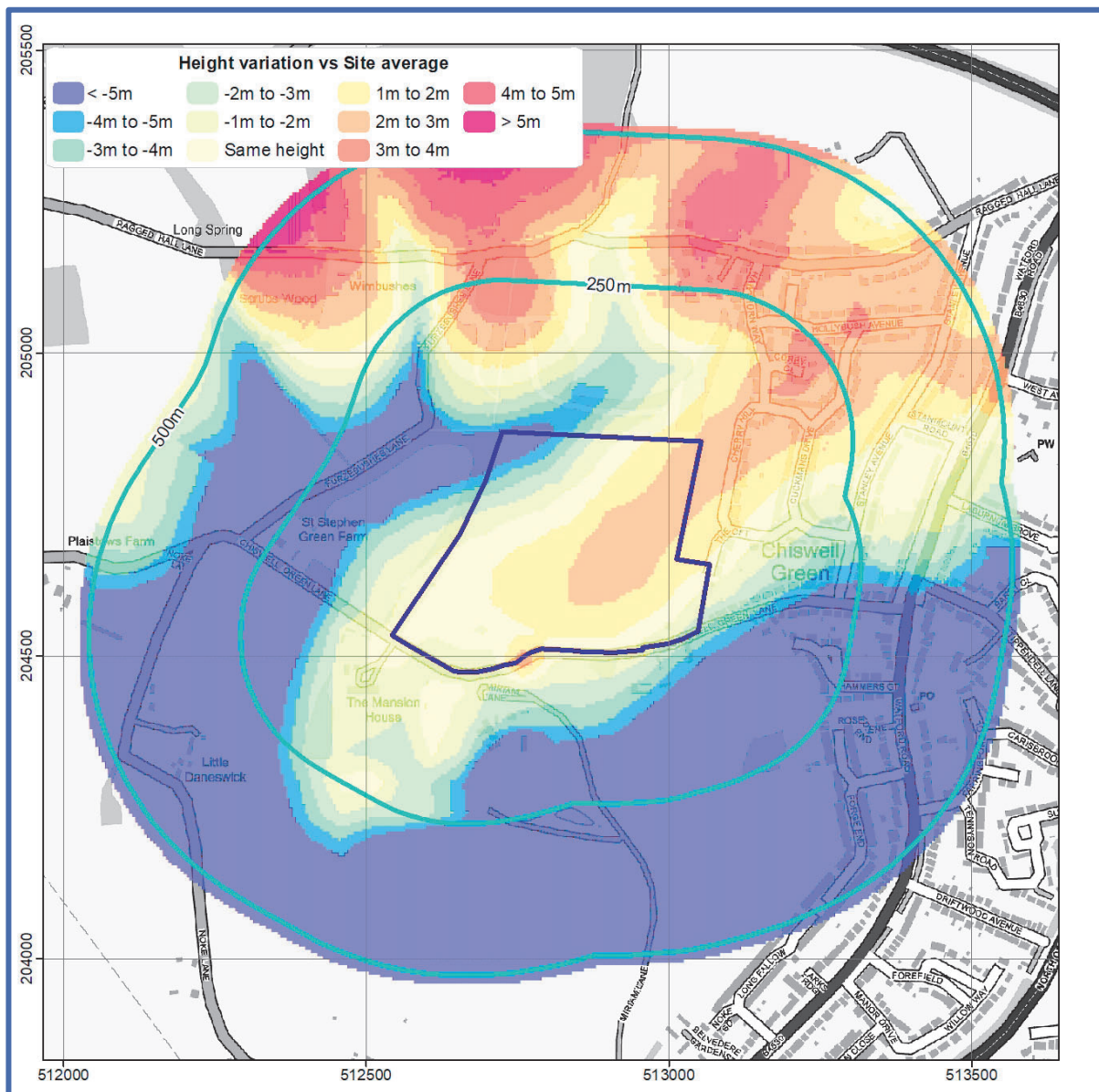


Site information

The Site is located in Chiswell Green in a setting of agricultural and residential land use at National Grid Reference TL 12832 04703. Site plans and drawings are provided in Appendix A.

The general ground levels on the Site are between 97.67 and 105.36 mAOD with the Site falling gradually in a south westerly direction. This is based upon a Site specific topographic survey undertaken by Tower Surveys in June 2021 (Appendix B).

Figure 1. Site Location and Relative Elevations (GeoSmart, 2021).



Contains Ordnance Survey data © Crown copyright and database right 2021

Development

The Site is currently used in an agricultural capacity for crop growth (micro-salad), cattle grazing and paddocks, and hay production, and has previously been used in a commercial capacity as a recreational sports ground for polo. A gravel track is on-Site to the south of the Site and four buildings are present, the largest being used for hay storage (drained via French drains and soakaway), a smaller shed used to grow micro salad, and two wooden stables used for hay storage. The Site has been confirmed to be 99 % greenfield in a report by Structural Soils in June 2021.

Development proposals are for the erection of 327 residential dwellings comprising of:

- 180 three-bed dwellings;
- 115 two-bed dwellings; and
- 32 one-bed dwellings.

Associated access road, garden and amenity, and parking are also proposed, with primary vehicular access to the Site from the south along Chiswell Green Lane. Pedestrian and cycling access are also proposed to the east along The Croft.

Site plans are included within Appendix A.

The effect of the overall development will result in an increase in number of occupants and/or users of the building and will result in the change of use, nature or times of occupation. According to Table 2 of the NPPG (2014), the vulnerability classification of the existing development is Water Compatible and proposed development is More Vulnerable. The estimated lifespan of the development is 100 years.

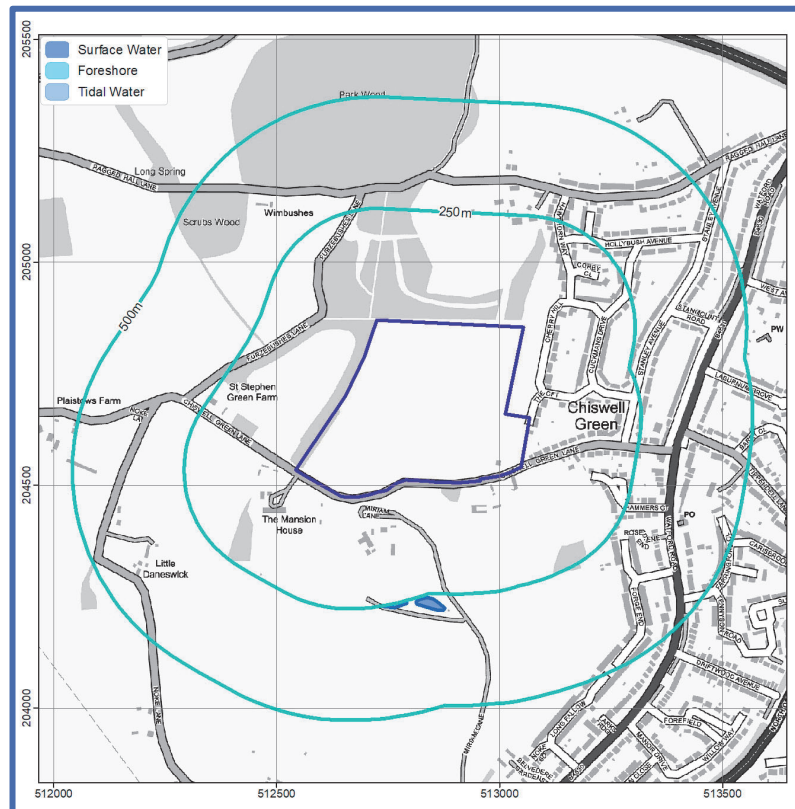
Hydrological features

According to Ordnance Survey (OS) mapping included in the following figure, there are no mapped surface watercourses within 500 m of the Site.

Proximity to relevant infrastructure

No relevant infrastructure has been identified within the vicinity of the Site (500 m).

Figure 2. Surface water features (EA, 2021)



Contains Ordnance Survey data © Crown copyright and database right 2021
Environment Agency copyright and database rights 2021

Hydrogeological features

British Geological Survey (BGS) mapping indicates the underlying superficial geology (Figure 3) consists of Kesgrave Catchment Subgroup (KGCA) (sand and gravel) covering 80 % of the Site (BGS, 2021) and is classified as a Secondary (A) Aquifer (EA, 2021).

BGS mapping indicates the underlying bedrock geology (Figure 4) consists of the Lewes Nodular Chalk Formation And Seaford Chalk Formation (undifferentiated) (LESE) (chalk) (BGS, 2021) and is classified as a Principal Aquifer (EA, 2021).

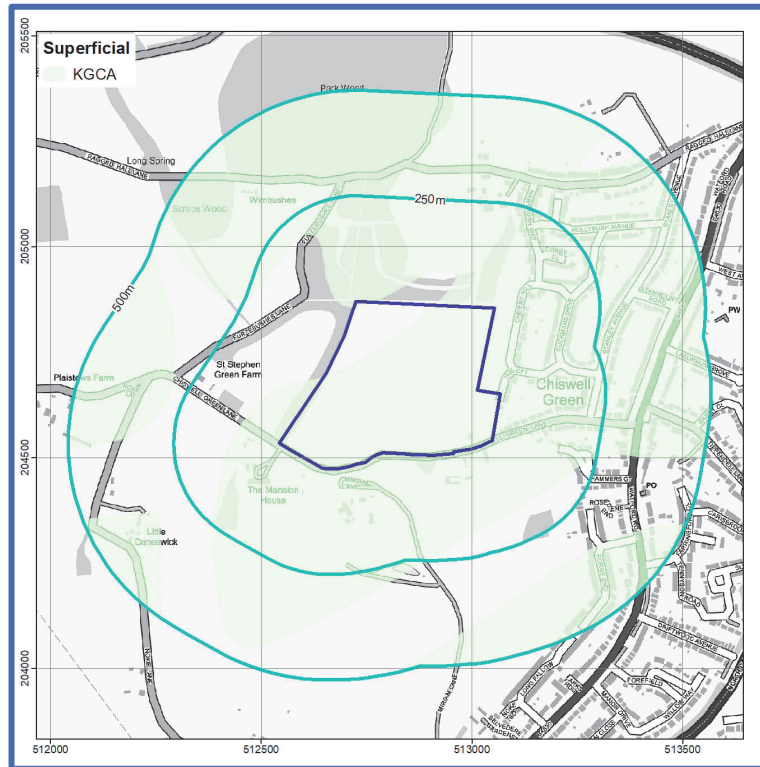
The Site lies within a total catchment groundwater Source Protection Zone (SPZ III) (EA, 2021).

A review of the BGS borehole database (BGS, 2021) indicates the nearest and most relevant borehole (ref: TL10SW22) is 20 m to the south of the Site boundary at an elevation of 103 mAOD and indicates glacial sand and gravel to 8.0 m below ground level (bgl) underlain by upper chalk to 8.02 bgl where the borehole was terminated. Water was not recorded to be struck.

The hydrogeological characteristics suggest there is potential for a groundwater table beneath the Site.

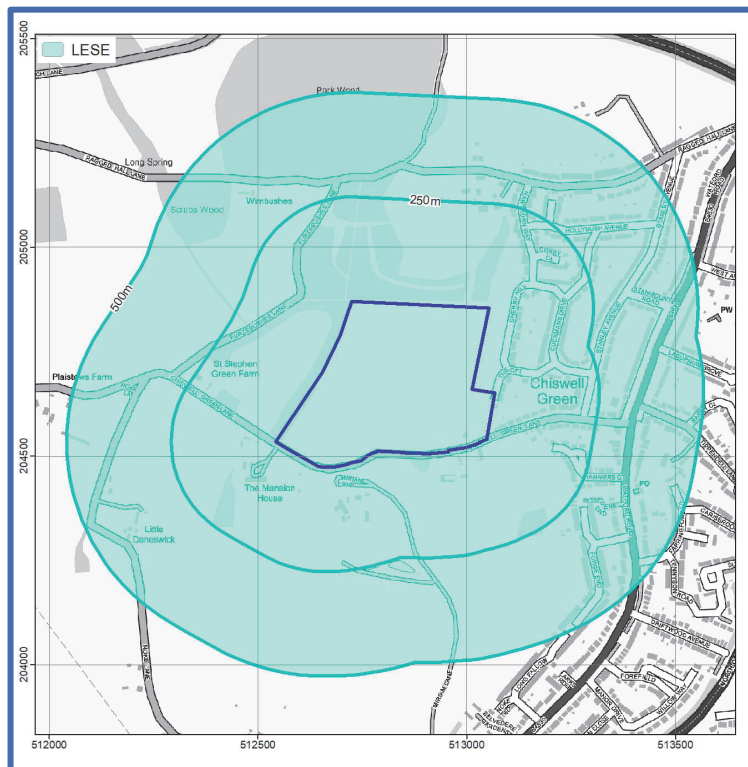
Groundwater levels may rise in the bedrock and superficial aquifer in response to prolonged rainfall recharge which may cause an unusually high peak in groundwater levels during some years, subject to hydraulic continuity between the groundwater system and the Site.

Figure 3. Superficial Geology (BGS, 2021)



Contains Ordnance Survey data © Crown copyright and database right 2021
Contains British Geological Survey materials © NERC 2021

Figure 4. Bedrock Geology (BGS, 2021)



Contains Ordnance Survey data © Crown copyright and database right 2021
Contains British Geological Survey materials © NERC 2021



Historical flood events

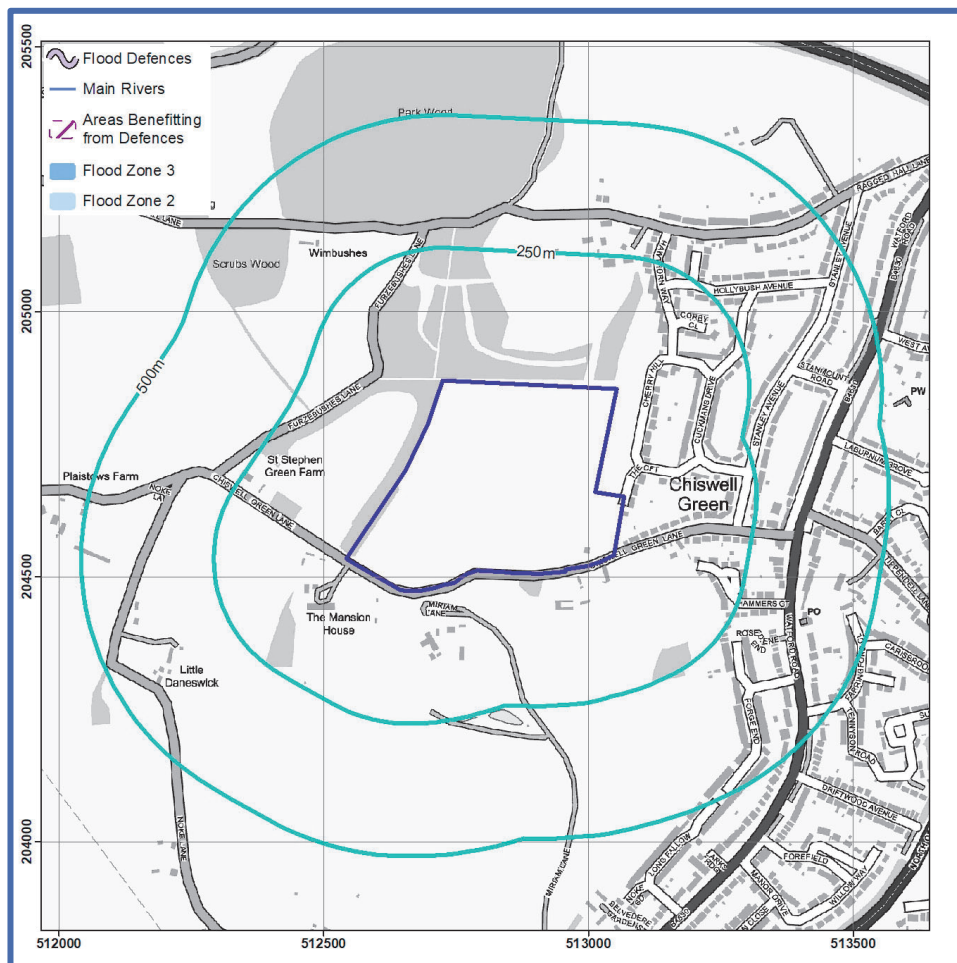
According to the EA's Historical Flood Map (EA, 2021) and the SFRA (JBA Consulting, 2014), no historical flood events have been recorded at the Site.

The purpose of historical flood data is to provide information on where and why flooding may have occurred in the past. The absence of any recorded events does not mean flooding has never occurred on-Site or that flooding will never occur at the Site.

Rivers (fluvial) / Sea (coastal/tidal) flooding

According to the EA's Flood Map for Planning Purposes (Figure 5), the Site is located within fluvial Flood Zone 1 and is therefore classified as having a Low probability of fluvial flooding. The Site lies approximately 1.7 km to the west of the nearest land within Flood Zones 2 and 3.

Figure 5. EA Flood Map for Planning Purposes (EA, 2021)



Contains Ordnance Survey data © Crown copyright and database right 2021
Environment Agency copyright and database rights 2021

As defined in the NPPF (2019):

Ignoring the presence of any defences, land located in a Flood Zone 1 is considered to have a Low probability of flooding, with less than a 1 in 1000 annual probability of fluvial or coastal flooding in any one year.

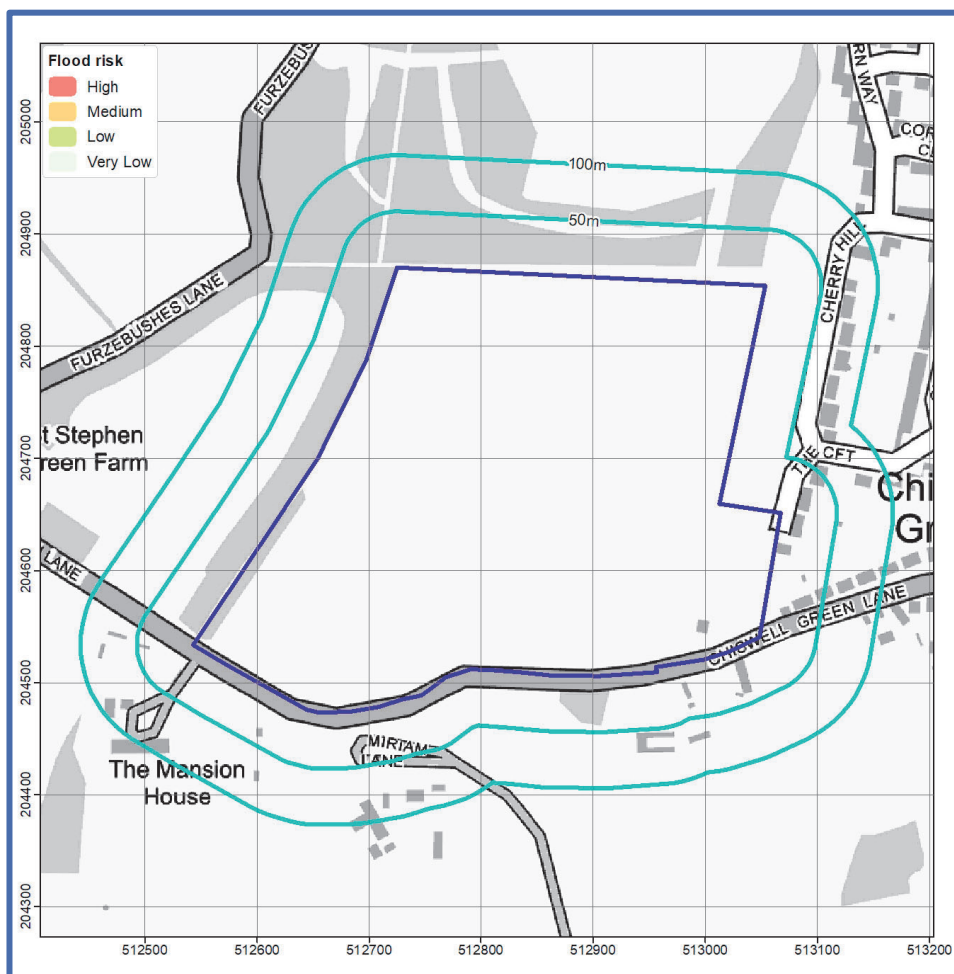
Development of all uses of land is appropriate in this zone (see glossary for terminology).

Flood risk including the benefit of defences

The type and condition of existing flood defences influence the 'actual' risk of fluvial flooding to the Site, albeit the long-term residual risk of flooding (ignoring the defences) should be considered when proposing new development.

According to the EA's Risk of Flooding from Rivers and the Sea (RoFRS) mapping (Figure 6), which considers the crest height, standard of protection and condition of defences, the flood risk from Rivers and the Sea is Very Low.

Figure 6. Risk of Flooding from Rivers and Sea map (EA, 2021)



Contains Ordnance Survey data © Crown copyright and database right 2021
Environment Agency copyright and database rights 2021

Surface water (pluvial) flooding

Surface water flooding occurs when intense rainfall exceeds the infiltration capacity of the ground and overwhelms the drainage systems. It can occur in most locations even at higher elevations and at significant distances from river and coastal floodplains.

According to the EA's Risk of Flooding from Surface Water (pluvial) flood mapping, the Site is at a variable risk of pluvial flooding ranging from Very Low to High.

Guidance

According to EA's surface water flood risk map the Site is at:

- Very Low risk - chance of flooding of less than 1 in 1000 (0.1%).
- Low risk - chance of flooding of between a 1 in 1000 & 1 in 100 (0.1% and 1%).
- Medium risk - chance of flooding of between a 1 in 100 and 1 in 30 (1% and 3.3%).
- High risk - chance of flooding of greater than 1 in 30 (3.3%).

During a Low risk (0.1 % AEP) event flood depths of up to between 0.15 and 0.3 m are anticipated to affect the area proposed for five houses in the north west corner of the Site (three two beds and two two-beds). An area of flooding up to 0.6 m is anticipated in the proposed garden areas of the two-bed dwellings affected.

During a Medium (1 % AEP) risk event, the above houses are anticipated to be affected by flood depths of up to 0.3 m and during a High (3.3 % AEP) risk event flood depths of up to 0.15 m. Figure 7 confirms the extent and depth of flooding during a 1 % AEP (1 in 100 year - Medium risk) event.

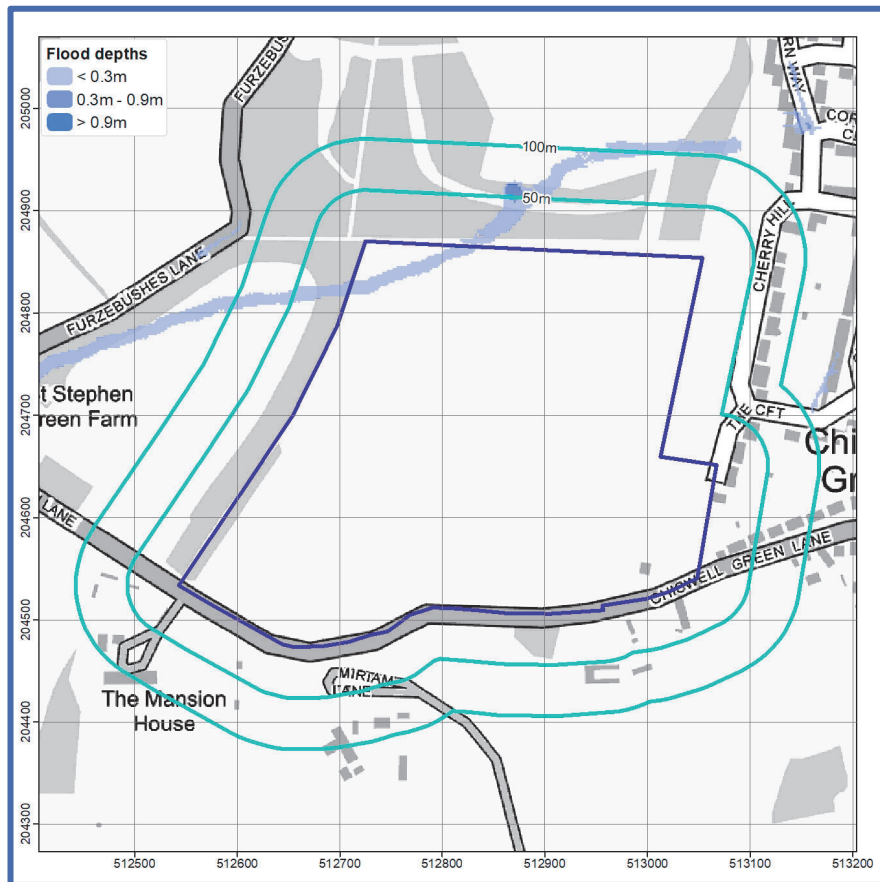
Guidance

According to EA's surface water flood risk map the following advisory guidance applies to the Site:

Flood Depth

- 0.15 to 0.3 m - Flooding would: typically exceed kerb height, likely exceed the level of a damp-proof course, cause property flooding in some areas
- 0.3 to 0.9 m - Flooding is likely to exceed average property threshold levels and cause internal flooding. Resilience measures are typically effective up to a water depth of 0.60m above floor level.

Figure 7. EA Medium surface water flood risk map (EA, 2021)



Contains Ordnance Survey data © Crown copyright and database right 2021
Environment Agency copyright and database rights 2021

Analysis of OS mapping, ground elevation data and the EA's pluvial flow route mapping in the 1 in 1000 year event confirms the Site is located on a potential overland flow route during a Low risk scenario.

During this event all of flow velocities are greater than 0.25 m/s. The flows could be unlikely to affect the buildings and/or access routes to the Site. Water may flow onto the Site from adjacent land to the north and should be managed, in addition to run-off generated on-Site. The Site may potentially transmit overland flows off-Site in a west direction.

A review of the Site plans, topography and the EA's Risk of Flooding from Surface Water Direction mapping indicates any overland flows on the Site would be obstructed by the proposed development but would occur across nonessential garden areas of the Site.

The SFRA does not indicate reported incidents of historical surface water flooding within 100 m of the Site (JBA Consulting, 2014).

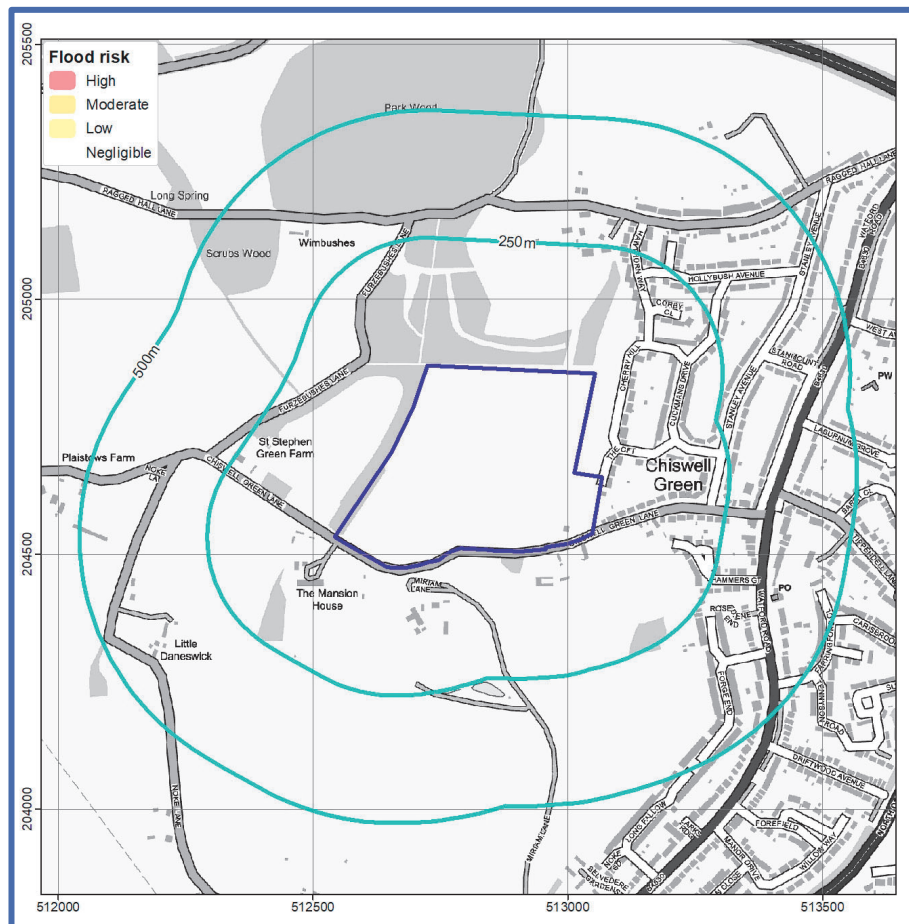
Climate change may lead to an increase in rainfall intensity which affects river levels, land and urban drainage systems. Rainfall intensity for small and urban catchments may increase from 5 to 20 % (central estimate) or 10 % to 40 % (Upper estimate) over the period to 2115 (EA, 2021). The Site is susceptible to overland flow and/or surface water flooding which may be increased as a result of climate change. On-Site surface water drainage systems should be designed appropriately to manage the run-off.

Groundwater flooding

Groundwater flooding occurs when sub-surface water emerges from the ground at the surface or into Made Ground and structures. This may be as a result of persistent rainfall that recharges aquifers until they are full; or may be as a result of high river levels, or tides, driving water through near-surface deposits. Flooding may last a long time compared to surface water flooding, from weeks to months. Hence the amount of damage that is caused to property may be substantially higher.

Groundwater Flood Risk screening data (Figure 8) indicates there is a Negligible risk of groundwater flooding at surface in the vicinity from permeable bedrock and superficial during a 1 in 100 year event.

Figure 8. GeoSmart GW5 Groundwater Flood Risk Map (GeoSmart, 2021)



Contains Ordnance Survey data © Crown copyright and database right 2021
Contains British Geological Survey materials © NERC 2021

Mapped classes combine likelihood, possible severity and the uncertainty associated with predicting the subsurface system. The map is a national scale screening tool to prompt site-specific assessment where the impact of groundwater flooding would have significant adverse consequences. Mapping limitations and a number of local factors may reduce groundwater flood risk to land and property even where it lies within mapped groundwater flood risk zones, which do not mean that groundwater floods will occur across the whole of the risk area.

The SFRA does not indicate reported incidents of historical ground water flooding within 20 m of the Site (JBA Consulting, 2014).

A site-specific assessment has been undertaken to refine the groundwater risk screening information on the basis of site-specific datasets (see Section 3) including BGS borehole data, and the EA's fluvial and tidal floodplain data (where available) to develop a conceptual groundwater model. The risk rating is refined further using the vulnerability of receptors including occupants and the existing and proposed Site layout, including the presence of basements and buried infrastructure. The presence of any nearby or on-Site surface water features such as drainage ditches, which could intercept groundwater have also been considered.

Based on a review of (limited) site specific data there is unlikely to be a mechanism for groundwater flooding at the Site and the risk is Negligible.

Site specific assessment suggests that groundwater levels are unlikely to reach the surface at the Site.

Borehole/geological data indicates the groundwater table is significantly below the Site. BGS borehole ref: TL10SW22 (8.2 m depth) did not record a water strike.

On the basis of the site-specific assessment the groundwater flood risk is considered to be Negligible.

The risks are higher for buried infrastructure and soak-away systems which may be affected by high groundwater levels.

Guidance

Negligible Risk - There will be a remote possibility that incidence of groundwater flooding could lead to damage to property or harm to other sensitive receptors at, or near, this location.

Climate change predictions suggest an increase in the frequency and intensity of extremes in groundwater levels. Rainfall recharge patterns will vary regionally resulting in changes to average groundwater levels. The impact of climate change on groundwater levels beneath the Site is linked to the variation in rainfall recharge which is uncertain. Based on the available evidence the resulting increase to groundwater flood risk is not considered significant.

Flooding from artificial sources

Artificial sources of flood risk include waterbodies or watercourses that have been amended by means of human intervention rather than natural processes. Examples include reservoirs (and associated water supply infrastructure), docks, sewers and canals. The flooding mechanism associated with flood risk from artificial sources is primarily related to breach or failure of structures (reservoir, lake, sewer, canal, flood storage areas, etc.)

Sewer flooding

Table 1-2 of Appendix A of the SFRA has identified 10 incidences or modelled incidences of flooding as a result of surcharging sewers within the AL2 3 postcode. However, it is recognised that this four digit postcode covers a large area and instances of flooding are not specific to the Site (JBA Consulting, 2014).

Guidance

Properties classified as “at risk” are those that have suffered, or are likely to suffer, internal flooding from public foul, combined or surface water sewers due to overloading of the sewerage system either once or twice in the ten year reference period. Records held by the sewage utility company provide information relating to reported incidents, the absence of any records does not mean that the Site is not at risk of flooding.

Canal failure

According to Ordnance Survey (OS) mapping, there are no canals within 500 m of the Site.

Water supply infrastructure

Water supply infrastructure is comprised of a piped network to distribute water to private houses or industrial, commercial or institution establishments and other usage points. In urban areas, this represents a particular risk of flooding due to the large amount of water supply infrastructure, its condition and the density of buildings. The risks of flooding to properties from burst water mains cannot be readily assessed.

If more information regarding the condition and history of the water supply infrastructure within the vicinity of the Site is required, then it is advisable to contact the local water supplier (Thames Water).

Culverts and bridges

The blockage of watercourses or structures by debris (that is, any material moved by a flowing stream including vegetation, sediment and man-made materials or refuse) reduces flow capacity and raises water levels, potentially increasing the risk of flooding. High water levels can cause saturation, seepage and percolation leading to failure of earth embankments or other structures. Debris accumulations can change flow patterns, leading to scour, sedimentation or structural failure.

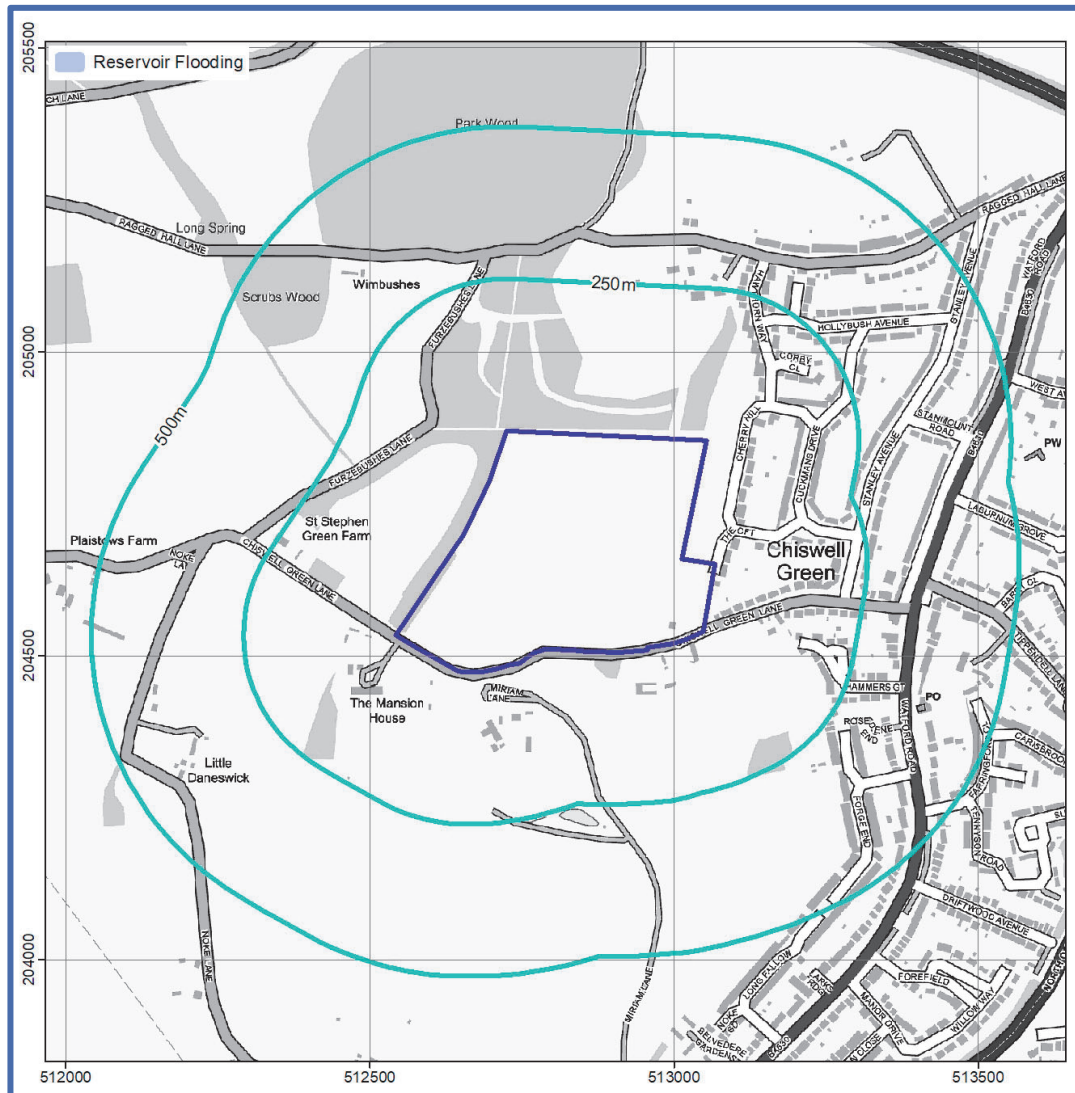
Culverts and bridges have not been identified within 500 m of the Site.

The SFRA has not identified any historic drainage issues within the Site area (JBA Consulting, 2014).

Reservoir flooding

According to the EA's Risk of Flooding from Reservoir mapping the Site is not at risk of flooding from reservoirs (Figure 9) (EA, 2021).

Figure 9. EA Risk of Reservoir Flooding (EA, 2021)



Contains Ordnance Survey data © Crown copyright and database right 2021
Environment Agency copyright and database rights 2021

Guidance

The risk of reservoir flooding is related to the failure of a large reservoir (holding over 25,000 m³ of water) and is based on the worst-case scenario. Reservoir flooding is extremely unlikely to occur (EA, 2021).

5. Flood risk from the development



Floodplain storage

As the development is located within Flood Zone 1, there would be no losses in floodplain storage as a result of the development.

Drainage and run-off

The proposed development involves an increase in the coverage of impermeable surfaces at the Site. As a result the rate and volume of runoff from the development is likely to increase over its lifetime. Therefore, an estimation of run-off is required to permit effective Site water management and prevent any increase in flood risk to off-Site receptors from the Site, over the lifetime of the proposed development.

The potential surface water run-off generated from the Site during a 1 in 100 year return period should be calculated, using FEH 2013 rainfall data from the online Flood Estimation Handbook (FEH), developed by NERC (2009) and CEH (2016).

The NPPF (2019) recommends the effects of climate change are incorporated into FRA's and the recently updated climate change guidance (published in 2016 and updated in 2019) confirms the requirements for inclusion within FRA's.

A surface water drainage strategy has been prepared separately (ref: 75188.01) to ensure surface water runoff can be managed effectively over the lifetime of the proposed development.

It is assumed that any changes to the existing drainage system will be undertaken in accordance with best practice and that care will be taken to ensure the new development does not overload/block any existing drainage or flow pathways to/from the Site.

6. Suitability of the proposed development



The information below outlines the suitability of proposed development in relation to national and local planning policy.

National policy and guidance

The aims of the national planning policies are achieved through application of the Sequential Test and in some cases the Exception Test.

Guidance

Sequential test: The aim of this test is to steer new development towards areas with the lowest risk of flooding (NPPF, 2019). Reasonably available sites located in Flood Zone 1 should be considered before those in Flood Zone 2 and only when there are no reasonably available sites in Flood Zones 1 and 2 should development in Flood Zone 3 be considered.

Exception test: In some cases, this may need to be applied once the Sequential Test has been considered. For the exception test to be passed it must be demonstrated that the development would provide wider sustainability benefits to the community that outweigh flood risk and a site-specific FRA must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

Suitability of the proposed development, and whether the Sequential and Exception Tests are required, is based on the Flood Zone the Site is located within and the flood risk vulnerability classification of the existing and proposed development. 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.

This report has been produced to assess all development types, prior to any development. The vulnerability classification and Flood Zones are compared within Table 4 overleaf (Table 3 of the NPPG (2014)).

As the Site is located within Flood Zone 1, all types of development listed within the Table overleaf are acceptable according to National Policy.

Table 2. Flood risk vulnerability and flood zone 'compatibility (taken from NPPG, 2014)

Flood risk vulnerability classification		Essential infrastructure	Water compatible	Highly vulnerable	More vulnerable	Less vulnerable
Flood Zone	Zone 1 – low probability	✓	✓	✓	✓	✓
	Zone 2 – medium probability	✓	✓	Exception test required	✓	✓
	Zone 3a – high probability	Exception test required	✓	X	Exception test required	✓
	Zone 3b – functional flood plain	Exception test required	✓	X	X	X

Local policy and guidance

For this report, several documents have been consulted for local policy and guidance and relevant information is outlined below:

South West Hertfordshire Level 1 Strategic Flood Risk Assessment (SFRA) (JBA Consulting, 2018)

“1.1.4 Sewers

Thames Water provided their sewer flooding register for the district which is detailed below in Table 1-2 and Figure 1-4. The largest number of incidents within a single postcode area is recorded in AL1, which covers St. Albans City. High numbers of incidents were also reported in AL2 and AL4, which also cover the city, but extend to London Colney, Sandridge and Wheathampstead. The mechanism of flooding is not specified in the register, however the presence of fluvial, surface water and groundwater flood risk in these areas suggests an interaction with the sewer network, perhaps through ingress or restricted outfalls at high river levels.”

7. Resilience and mitigation



Based on the flood risk identified at the Site, the national and local policies and guidance and proposed development, the mitigation measures outlined within this section of the report are likely to help protect the development from flooding.

Sea (coastal/tidal) flood mitigation measures

As the Site is not identified as being at risk of flooding from the sea, mitigation measures are not required.

Rivers (fluvial) flood mitigation measures

As the Site is not identified as being at risk of flooding from fluvial sources, mitigation measures are not required.

Surface water (pluvial) flood mitigation measures

A Very Low to High surface water (pluvial) flooding risk has been identified at the Site, anticipated to affect five plots in the north west.

In order to ensure the development includes sufficient flood mitigation measures to reduce the risk of pluvial flooding over its lifetime, the flood depths, levels and appropriate mitigation measures are summarised below, for the five affected plots:

Finished floor levels of the proposed development should be set at least 0.3 m above existing ground elevation.

Where Finished floor levels cannot be set at the recommended elevation, the floor levels should be set as high as possible and flood resilience measures included:

Additional Mitigation

Where it is not possible to raise the minimum finished floor levels to the recommended elevation, it may be appropriate to adopt a water exclusion strategy for flood depths up to 0.3 m in line with the EA's Standing Advice. A water exclusion strategy, using avoidance and resistance measures, is appropriate where floods are expected to last for short durations. Potential water exclusion strategies include:

- Passive flood door systems;
- Temporary flood barriers;
- Air brick covers (manual or automatic closing); and
- Non-return flap valves on sewer outfalls.

A surface water drainage strategy has been prepared separately (ref: 75188.01) to ensure surface water runoff can be managed effectively over the lifetime of the proposed development.

In addition, the regular maintenance of any drains and culverts surrounding/on the Site should be undertaken to reduce the flood risk.

Groundwater flood mitigation measures

As the Site is not identified as being at risk of groundwater flooding, mitigation measures are not required.

Reservoir flood mitigation measures

The Site is not a risk of flooding from reservoirs; therefore, mitigation measures are not required.

Other flood risk mitigation measures

A risk has been identified from sewers, although the level of risk could not be determined.

A sewer flooding history search was undertaken using the Strategic Flood Risk Assessment (JBA Consulting, 2014). Table 1-2 of Appendix A of the SFRA has identified 10 incidences or modelled incidences of flooding as a result of surcharging sewers within the AL2 3 postcode. However, it is recognised that this four digit postcode covers a large area and instances of flooding are not specific to the Site.

Residual flood risk mitigation measures

The risk to the Site has been assessed from all sources of flooding and appropriate mitigation and management measures proposed to keep the users of the development safe over its lifetime. There is however a residual risk of flooding associated with the potential for failure of mitigation measures if regular maintenance and upkeep isn't undertaken. If mitigation measures are not implemented or maintained, the risk to the development will remain as the baseline risk.

Further flood mitigation information

More information on flood resistance, resilience and water entry can be found here:
http://www.planningportal.gov.uk/uploads/br/flood_performance.pdf
www.knowyourfloodrisk.co.uk

8. Conclusions and recommendations



Table 3. Risk ratings following implementation and subsequent maintenance of mitigation measures

Table 4. Source of Flood Risk	Baseline	After Mitigation
River (fluvial) and Sea (coastal/tidal)	Very Low	N/A
Surface water (pluvial) flooding	Very Low to High	Very Low to Medium
Groundwater flooding	Negligible	N/A
Other flood risk factors present	Yes	Yes ¹
Is any other further work recommended?	Yes	Yes (see below)

N/A = mitigation not required

¹A risk has been identified from sewers, although the level of risk could not be determined.

The table below provides a summary of where the responses to key questions are discussed in this report. Providing the recommended mitigation measures are put in place it is likely that flood risk to this Site will be reduced to an acceptable level.

Table 5. Summary of responses to key questions in the report

Key sources of flood risks identified	Yes, pluvial (see Section 4).
Are standard mitigation measures likely to provide protection from flooding to/from the Site?	Yes (see Section 7).
Is any further work recommended?	Yes
<p>Finished floor levels of the proposed development should be set at least 0.3 m above existing ground elevation.</p> <p>Where it is not possible to raise the minimum finished floor levels to the recommended elevation, it may be appropriate to adopt a water exclusion strategy for flood depths up to 0.3 m in line with</p>	

the EA's Standing Advice. A water exclusion strategy, using avoidance and resistance measures, is appropriate where floods are expected to last for short durations. Potential water exclusion strategies include:

- Passive flood door systems;
- Temporary flood barriers;
- Air brick covers (manual or automatic closing); and
- Non-return flap valves on sewer outfalls.

A surface water drainage strategy has been prepared separately (ref: 75188R1) to ensure surface water runoff can be managed effectively over the lifetime of the proposed development.

In addition, the regular maintenance of any drains and culverts surrounding/on the Site should be undertaken to reduce the flood risk.

9. References and glossary



References

British Geological Survey (BGS) (2021). Geology of Britain Viewer. Accessed from: <http://mapapps.bgs.ac.uk/geologyofbritain/home.html> on 20/07/21.

Department for Communities and Local Government (2019). National Planning Policy Framework (NPPF). Accessed from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/810197/NPPF_Feb_2019_revised.pdf on 20/07/21.

Defra/Environment Agency (2005). Flood Risk Assessment Guidance for New Development. *Phase 2 Framework and Guidance for Assessing and Managing Flood Risk for New Development – Fill Documentation and Tools*. R & D Technical Report FD232-/TR2.

Environment Agency [EA] (2021). Flood risk assessments: climate change allowances. Accessed from: <https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances> on 20/07/21.

Environment Agency [EA] (2021). MagicMap. Accessed from: <http://magic.defra.gov.uk/MagicMap.aspx> on 20/07/21.

Environment Agency [EA] (2021). Flood map for planning. Accessed from <https://flood-map-for-planning.service.gov.uk/> on 20/07/21.

Environment Agency [EA] (2021). Long term flood risk assessment for locations in England. Accessed from <https://flood-warning-information.service.gov.uk/long-term-flood-risk> on 20/07/21.

GeoSmart (2021). GeoSmart groundwater flood risk (GW5) map (version 2.4).

Ministry of Housing, Communities & Local Government (2014). Planning Practice Guidance (NPPG). Flood Risk and Coastal Change. Accessed from <http://planningguidance.planningportal.gov.uk/blog/guidance/flood-risk-and-coastal-change/> on 20/07/21.

Ordnance Survey Mapping (2021). © Crown copyright. All rights reserved. Licence number AL 100054687. For full terms and conditions visit: www.ordnancesurveyleisure.co.uk

JBA Consulting (2018). South West Hertfordshire Level 1 Strategic Flood Risk Assessment. Accessed from: <https://www.stalbans.gov.uk/environment-documents> on 20/07/21.

Survey Open Data (2021). Accessed from: <http://www.geostore.com/environment-agency/survey.html#/survey/tandc> on 20/07/21.

Glossary

General terms

BGS	British Geological Survey
EA	Environment Agency
GeoSmart groundwater flood risk model	GeoSmart's national groundwater flood risk model takes advantage of all the available data and provides a preliminary indication of groundwater flood risk on a 50m grid covering England and Wales. The model indicates the risk of the water table coming within 1 m of the ground surface for an indicative 1 in 200 year return period scenario.
Dry-Island	An area considered at low risk of flooding (e.g. In a Flood Zone 1) that is entirely surrounded by areas at higher risk of flooding (e.g. Flood Zone 2 and 3)
Flood resilience	Flood resilience or wet-proofing accepts that water will enter the building, but through careful design will minimise damage and allow the re-occupancy of the building quickly. Mitigation measures that reduce the damage to a property caused by flooding can include water entry strategies, raising electrical sockets off the floor, hard flooring.
Flood resistance	Flood resistance, or dry-proofing, stops water entering a building. Mitigation measures that prevent or reduce the likelihood of water entering a property can include raising flood levels or installation of sandbags.
Flood Zone 1	This zone has less than a 0.1% annual probability of river flooding
Flood Zone 2	This zone has between 0.1 and 1% annual probability of river flooding and between 0.1% and 0.5 % annual probability sea flooding
Flood Zone 3	This zone has more than a 1% annual probability of river flooding and 0.5% annual probability of sea flooding
Functional Flood Plain	An area of land where water has to flow or be stored in times of flood.
Hydrologic model	A computer model that simulates surface run-off or fluvial flow. The typical accuracy of hydrologic models such as this is $\pm 0.25\text{m}$ for estimating flood levels at particular locations.
OS	Ordnance Survey
Residual Flood Risk	The flood risk remaining after taking mitigating actions.
SFRA	Strategic Flood Risk Assessment. This is a brief flood risk assessment provided by the local council

SuDS A Sustainable drainage system (SuDS) is designed to replicate, as closely as possible, the natural drainage from the Site (before development) to ensure that the flood risk downstream of the Site does not increase as a result of the land being developed. SuDS also significantly improve the quality of water leaving the Site and can also improve the amenity and biodiversity that a Site has to offer. There are a range of SuDS options available to provide effective surface water management that intercept and store excess run-off. Sites over 1 Ha will usually require a sustainable drainage assessment if planning permission is required. The current proposal is that from April 2014 for more than a single dwelling the drainage system will require approval from the SuDS Approval Board (SABs).

Aquifer Types

Principal aquifer These are layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale.

Secondary A aquifer Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.

Secondary B aquifer Predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering.

Secondary undifferentiated Has been assigned in cases where it has not been possible to attribute either category A or B to a rock type due to the variable characteristics of the rock type.

Unproductive Strata These are rock layers or drift deposits with low permeability that has negligible significance for water supply or river base flow.

NPPF (2019) terms

Exception test Applied once the sequential test has been passed. For the exception test to be passed it must be demonstrated that the development provides wider sustainability benefits to the community that outweigh flood risk and a site-specific FRA must demonstrate that the development will be safe for its lifetime taking account of the vulnerability of its users, without increasing flood risk elsewhere, and, where possible, will reduce flood risk overall.

Sequential test Aims to steer new development to areas with the lowest probability of flooding.

Essential infrastructure Essential infrastructure includes essential transport infrastructure, essential utility infrastructure and wind turbines.

Water compatible	Water compatible land uses include flood control infrastructure, water-based recreation and lifeguard/coastal stations.
Less vulnerable	Less vulnerable land uses include police/ambulance/fire stations which are not required to be operational during flooding and buildings used for shops/financial/professional/other services.
More vulnerable	More vulnerable land uses include hospitals, residential institutions, buildings used for dwelling houses/student halls/drinking establishments/hotels and sites used for holiday or short-let caravans and camping.
Highly vulnerable	Highly vulnerable land uses include police/ambulance/fire stations which are required to be operational during flooding, basement dwellings and caravans/mobile homes/park homes intended for permanent residential use.

Data Sources

Aerial Photography	Contains Ordnance Survey data © Crown copyright and database right 2021 BlueSky copyright and database rights 2021
Bedrock & Superficial Geology	Contains British Geological Survey materials © NERC 2021 Ordnance Survey data © Crown copyright and database right 2021
Flood Risk (Flood Zone/RoFRS/Historic Flooding/Pluvial/Surface Water Features/Reservoir/ Flood Alert & Warning)	Environment Agency copyright and database rights 2021 Ordnance Survey data © Crown copyright and database right 2021
Flood Risk (Groundwater)	GeoSmart, BGS & OS GW5 (v2.4) Map (GeoSmart, 2021) Contains British Geological Survey materials © NERC 2021 Ordnance Survey data © Crown copyright and database right 2021
Location Plan	Contains Ordnance Survey data © Crown copyright and database right 2021
Topographic Data	OS LiDAR/EA Contains Ordnance Survey data © Crown copyright and database right 2021 Environment Agency copyright and database rights 2021