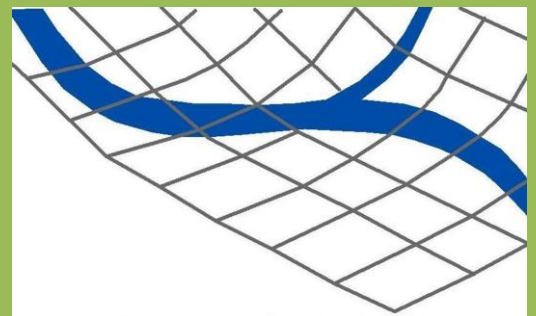
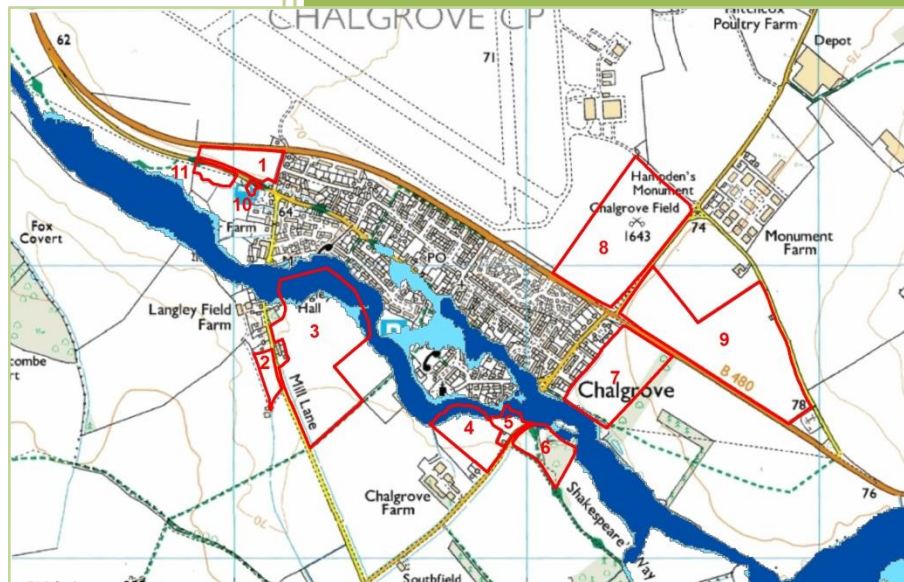


2014

Chalgrove Neighbourhood Plan Strategic Flood Risk Assessment



HYDRO-GIS Ltd

22nd October 2014

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Chalgrove Neighbourhood Plan

Strategic Flood Risk Assessment

Introduction

Hydro-GIS Ltd was commissioned by the Chalgrove Neighbourhood Plan committee to undertake a flood risk assessment for 11 potential greenfield development sites within Chalgrove Parish as shown on the overview map in Figure 1. This assessment has been made at a strategic level, making use largely of published information and computer modelling techniques. It is not intended as a detailed site specific study where flood risk is quantified for a specific development and no mitigation measures are recommended.

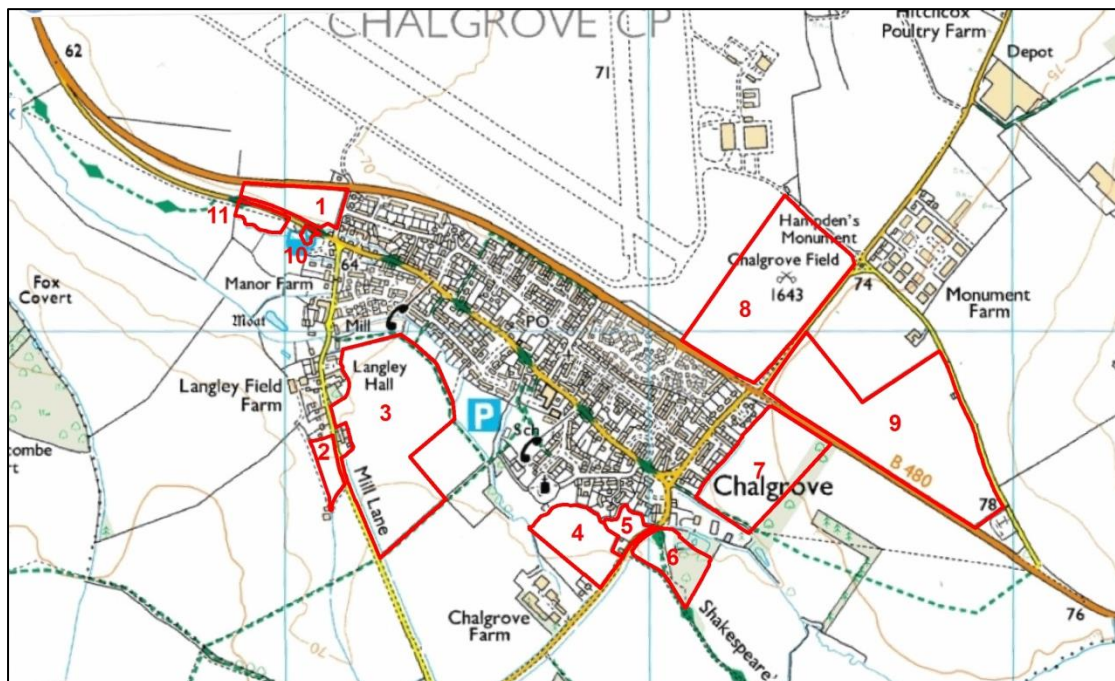


Figure 1 The location of the 11 potential development sites around Chalgrove (background OS 1:25000 sheet 171)

This report outlines the different types of flood risk and the methods used to assign flood risk to each site. Each of the sites is then dealt with individually.

Methodology

The study considers flood risk from a range of sources: rivers, groundwater, surface water, and water infrastructure. The information used to identify each specific aspect of flood risk is outlined in the following sections and summarised in Table 1.

River Flood Risk

This is also known as fluvial flooding and identified by the Environment Agency's flood zones available as maps on the EA website "What's in your back yard". These maps show the predicted flood outlines for a flood event which would occur on average just once in a period of 100 years (zone 3, high risk), and the outlines for an event which would occur on average just once in 1000 years (zone 2, medium risk). This is also known as the extreme flood outline and denotes a greater magnitude flood than the 1 in 100 year flood. An example for Chalgrove is shown in Figure 2. These outlines are predicted based on a fairly general methodology to estimate the flows in all designated main rivers in the UK. The extent of out of bank flooding is mapped using a cell based computer modelling routine and a digital terrain model (DTM) of the ground surface which is represented by a point level (spot height) every 5m. These maps are not particularly accurate and generally present an over-estimate of the flooding since they only map the out of bank flooding and do not consider the potential for storage of water within the river channel. Rather unusually the maps in Chalgrove are underestimates of the flood risk probably due to the incorrect delineation of the High Street channel. For major rivers such as the Thames the flood zones are the results of much more detailed studies which include the surveying of the river channel to generate cross sections and therefore get a proper estimate of the channel capacity, the use of computer models with output validated against observed flood events, and higher resolution DTMs generated from 1m interval spot heights. The flood zones together with the proposed development sites are shown in Figure 3.

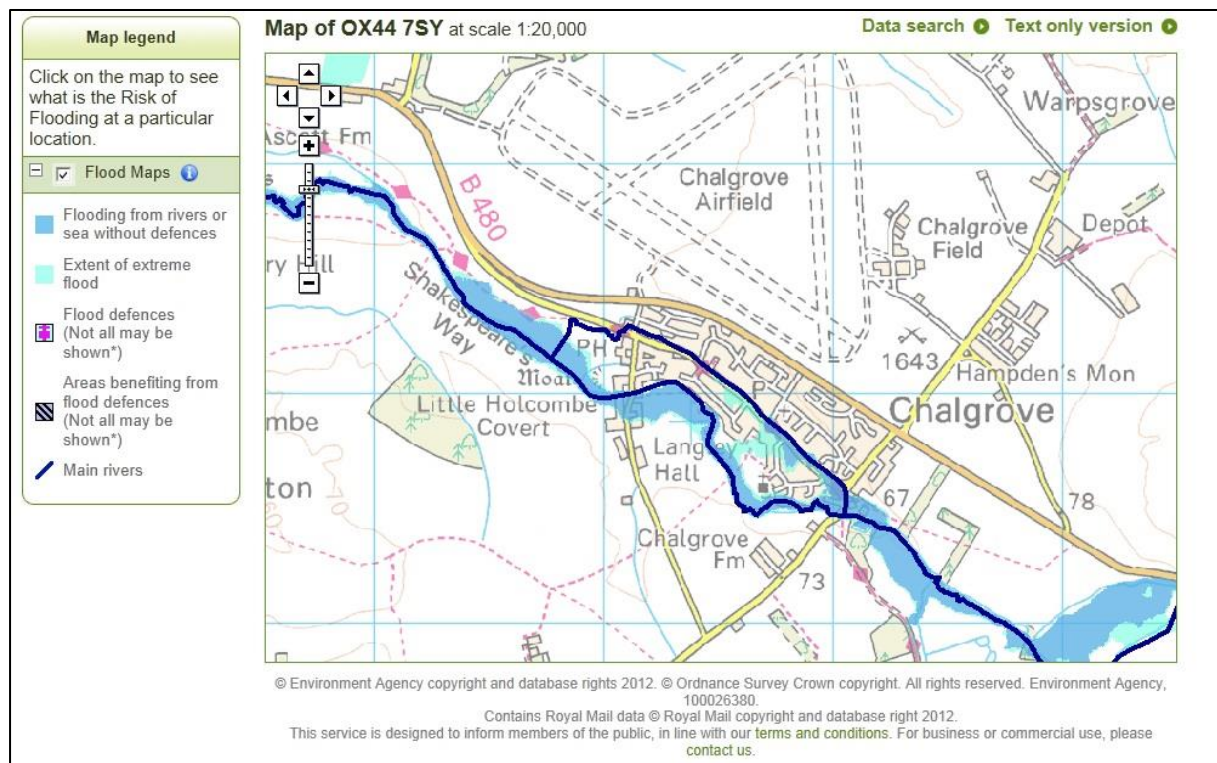


Figure 2 Environment Agency flood zone map for Chalgrove.

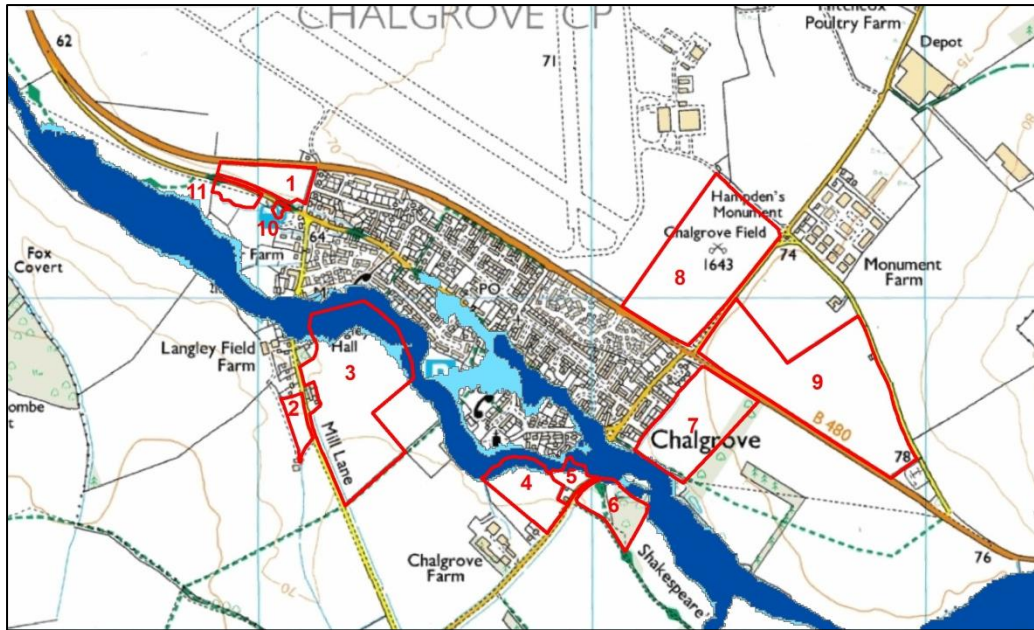


Figure 3 The EA flood zones in relation to the development sites.

Historical flood outlines also provide an indication of the risk of flooding from rivers. These are also provided by the Environment Agency and are mostly available for recent events on the main rivers based often on surveys and aerial photos. This information is not freely available and has to be purchased from the Environment Agency. No historical flood outlines are held by the EA for Chalgrove, however maps of recent flood extents have been generated as part of this study based on photographic (Figure 4) and video evidence. The outlines are shown in Figure 5, they represent both out of bank flooding from rivers and surface water flooding from minor watercourses, impermeable surfaces, and ponding following heavy rainfall. The flood outlines have been mapped from evidence of flooding in 2008, 2009, 2013 and 2014. The photographic record did not cover the entire village so any further evidence presented by residents to the Parish Council or Development Plan could be added to the map.



Figure 4 Flooding of the High Street from the Chalgrove Brook in June 2008.

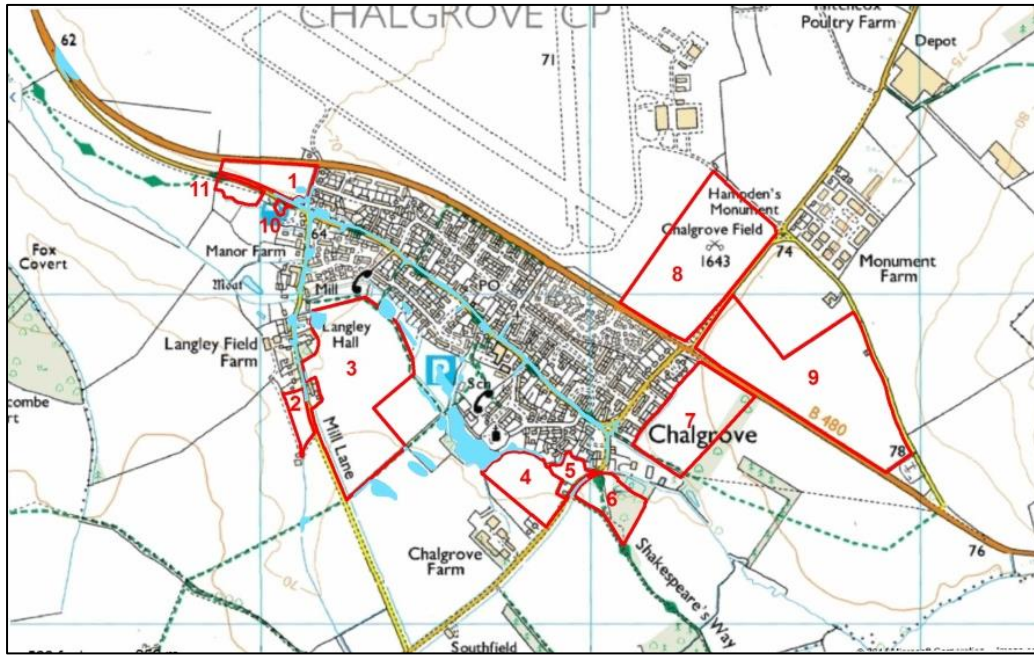


Figure 5 Mapped historical flood outlines for Chalgrove.

The study has also aimed to consider basic hydrological modelling and field surveying to identify the risk of flooding at stream channels bordering many of the sites. The idea was to survey the stream channel cross section and apply an equation to calculate the relationship between the flow and water levels. However at many locations it was impossible to gain safe access to the channel due to vegetation growth. Often the only places where channels could be surveyed were at bridge crossings, like the Berrick Road, where the channel was engineered and no longer in its natural state. Calculations were not undertaken and instead it was just noted whether channels flowed through or bordered the development sites.

Groundwater Flood Risk

Groundwater flooding refers to water which originates from aquifers such as the Chalk and issues to the surface at springs following severe and prolonged rainfall. The receiving water to the aquifer can be over many tens of square kilometres and water levels can remain high for many weeks or months. The water will emerge at the surface either at the boundary between the permeable rock and an impermeable layer (e.g. chalk over clay), where the landscape provides a natural depression for the water to collect such as a dry valley, or where infrastructure provides a conduit for the groundwater (e.g. a borehole or sewer). Such flooding was experienced in the winter and spring of 2014 and also affected other local villages such as Ewelme and Cuxham. The EA represents groundwater flood risk with maps of groundwater vulnerability to pollution and flooding (Figure 6). These maps are often included in strategic flood risk assessments (SFRA) and the SODC SFRA includes a map showing incidents of groundwater flooding and the EA classification of groundwater vulnerability. The classification is based on geology maps provided by the British Geological Survey (Figure 7). The vulnerability map shows areas of alluvium through the centre of Chalgrove as high vulnerability and the gravel areas to the north as intermediate vulnerability. The areas underlain by the impermeable Gault Clay are unclassified since this bedrock is not an aquifer.

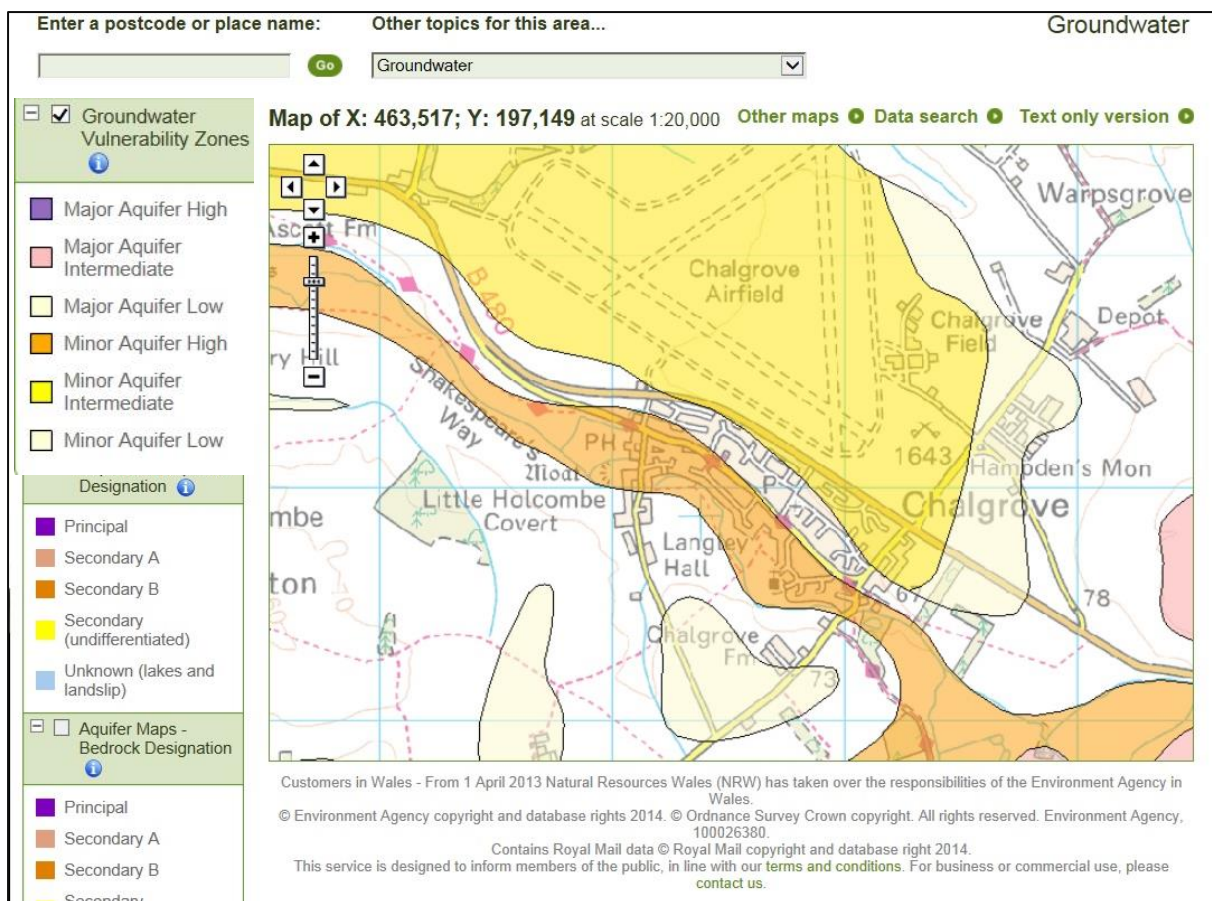


Figure 6 Groundwater Risk maps for Chalgrove.

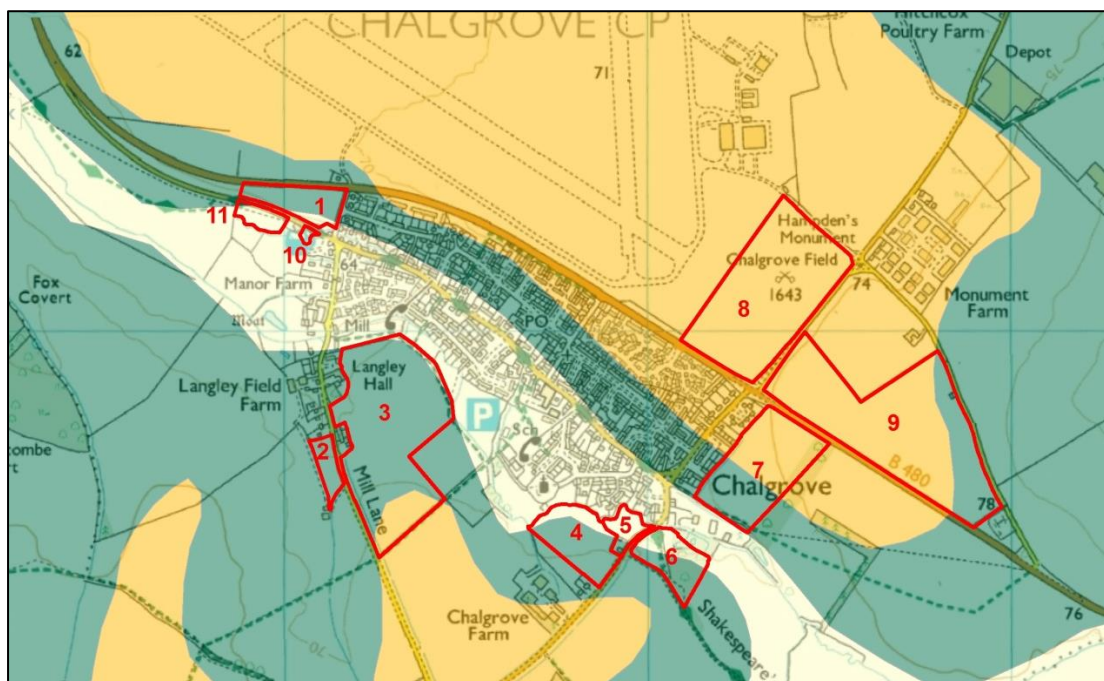


Figure 7 Geology around Chalgrove: green: Gault clay; beige: Alluvium; orange Sandford and Radley Gravel Member (based on data from the BGS 2014).

Soil maps available through the Soilscales website run by Cranfield University also give an indication of groundwater levels (Figure 8). The soils in areas at risk of groundwater flooding can be classified as being naturally wet, prone to seasonal waterlogging, high groundwater and with poor or impeded drainage. Again the area of alluvium in Chalgrove is classified in this way as being naturally wet floodplain soils with high groundwater. Locally high levels of water in permeable soil layers above impermeable bedrock following heavy rainfall do not constitute groundwater flooding. This is a feature of some of the Gault Clay areas, with a contributing area much smaller than the Chalk ground water in the order of a few hectares at the most. Despite water having originated from the ground this feature is periodic with the water table rapidly falling after the rainfall event rather than the continuous high water levels experienced in true groundwater flooding. This type of flood risk is better classified under surface water flooding.

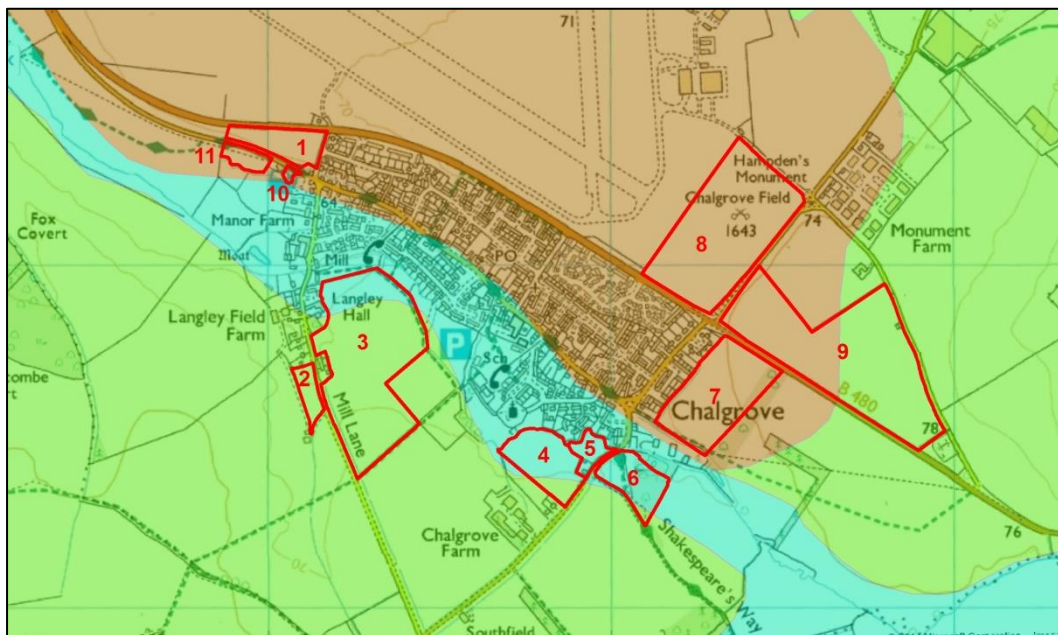


Figure 8 Soils around Chalgrove: brown: free draining; blue: wet floodplain soils; green: impeded drainage.

Surface Water Flood Risk

Surface water flooding directly from the overland flow and ponding of heavy rainfall is also a risk which needs to be considered, especially after the floods of July 2007 where many areas were flooded through this mechanism. Such surface water flooding is generally a feature of urban areas with a high proportion of impermeable surfaces such as roads, roofs, parking, pavements and driveways. Surface water flooding is also a feature of rural areas when the soils can be saturated following prolonged wet periods, such as the winter of 2014, or when the intensity of the rain is so high that the infiltration capacity of the soil is exceeded, as in severe summer thunderstorms. The EA and local authorities have also classified areas as surface water flooding when the flooding has originated from non-main rivers – namely small streams and drainage ditches. Maps of surface water flooding are available on the EA website (Figure 9). They show the risk resulting from a defined rainfall event of a given magnitude (i.e. return period) and duration. The maps depict where the rain will flow and pond once it reaches the surface based on the same resolution DTM as used for the flood zone maps. The maps are generated from a grid cell based modelling routine where water from any cell will flow to the neighbouring cells of lowest altitude, although little detail is given by the EA as to how this actually works and there are concerns over the accuracy of this method.

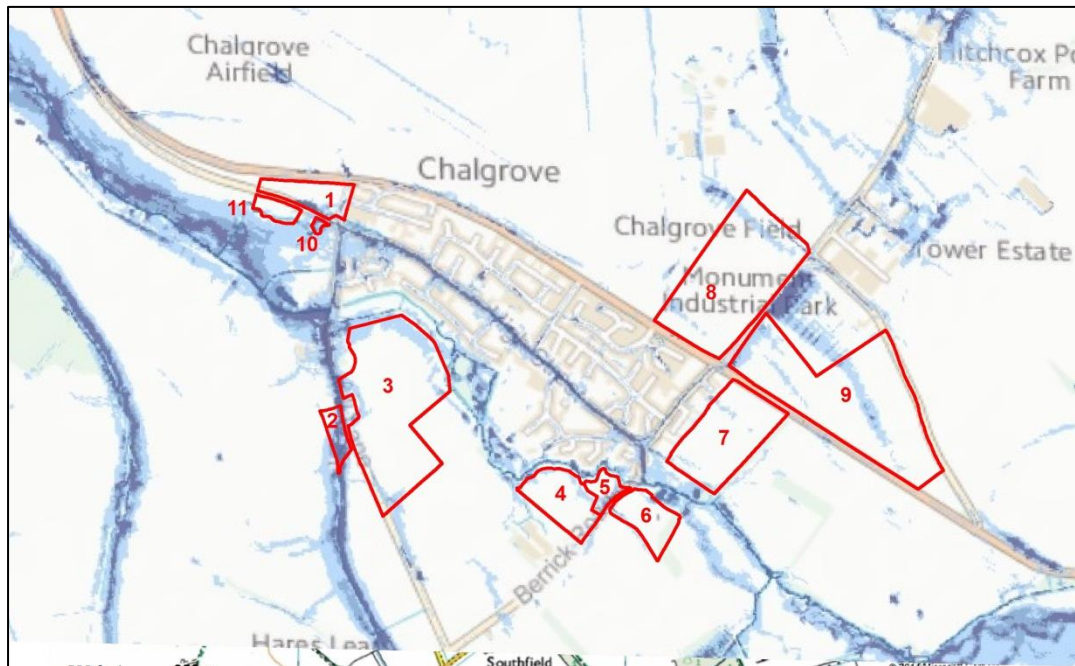


Figure 9 EA surface water flood risk maps for Chalgrove.

Sometimes historical surface water flooding locations are also mapped by the EA or local authorities; however the SFRA does not include any historical surface water flooding. Known areas of surface water flooding in Chalgrove based on photos (Figure 10), videos and observations have also been mapped as part of this study (see Figure 5).



Figure 10 Surface water flooding on the B480 near the western entrance to Chalgrove in June 2008.

Another way to identify potential surface water flood risk both at a specific site and how water from the site may impact on other areas is through the use of the DTM to identify flow pathways. Computer modelling techniques using Geographical Information Systems (GIS) software can delineate the natural path that water would take based on the flow direction from one DTM cell to its neighbours and the accumulation of these DTM cells. Flow pathways for the area around Chalgrove have been derived for this study based on a 5m resolution DTM. These pathways (Figure 11) show the locations of cells which receive water from a minimum of 1000 contributing cells (an area of at least 25,000 m²). The network of these flow pathways is similar to the surface water flood risk and also the river network. What is interesting however is that there is not a continuous flow pathway which follows the course of the main Chalgrove Brook channel. This demonstrates the fact that the original course of the channel was through the centre of the village, effectively along the High Street, whereas the current main channel is actually the result of a diversion to the mill.

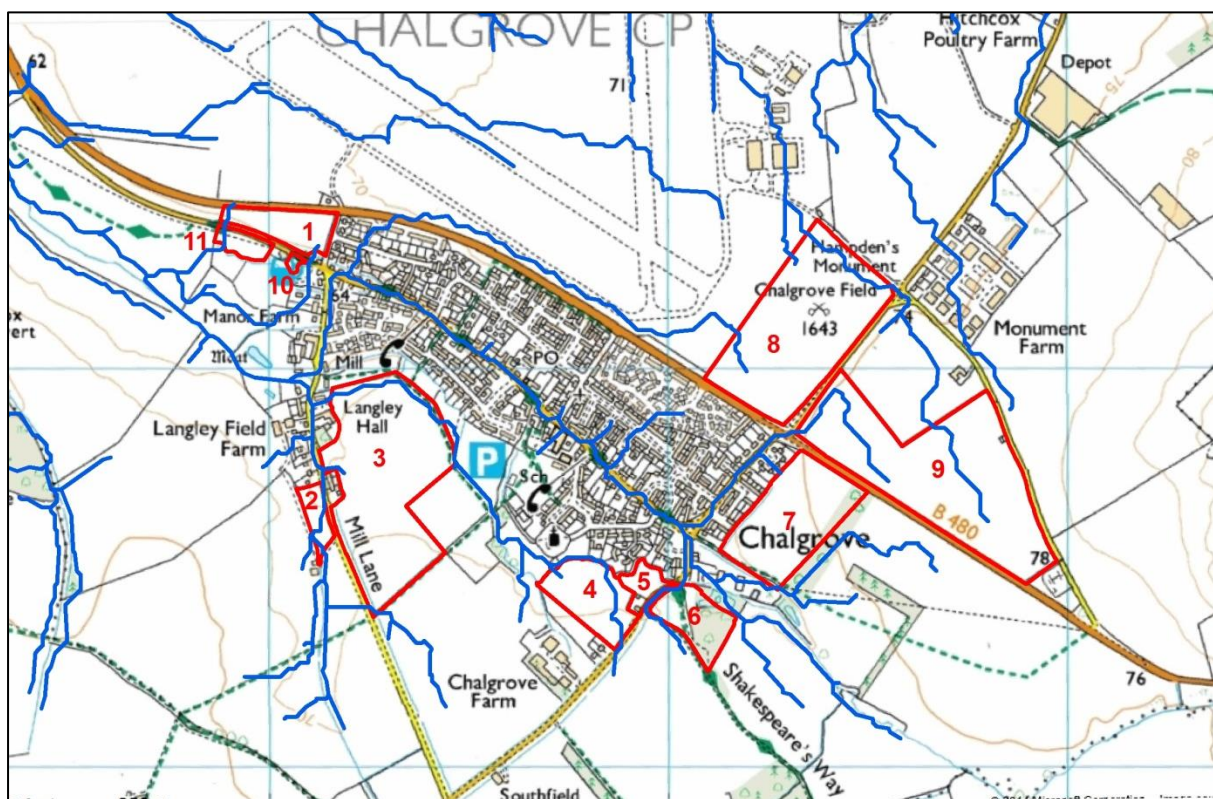


Figure 11 Flow pathways around Chalgrove based on the DTM.

Sewer / Infrastructure Flood Risk

Maps of foul and surface water sewers, water mains and other water infrastructure were requested from Thames Water. In addition, records of flooding from these structures failing were also requested. The maps provided do not cover the full extent of the development sites (Figure 12) and are not in an appropriate format (they are just pdf files) to use in Arc GIS (see the Mapping Methodology section below). Without this information it is not possible to provide an assessment of the flood risk from infrastructure which would be consistent with the other forms of flooding. Although the information was not available for this report, the neighbourhood plan recognises the need for detailed site specific developer drainage strategies, with infrastructure in place prior to development being occupied, and will proactively engage with Thames Water on proposed developments.

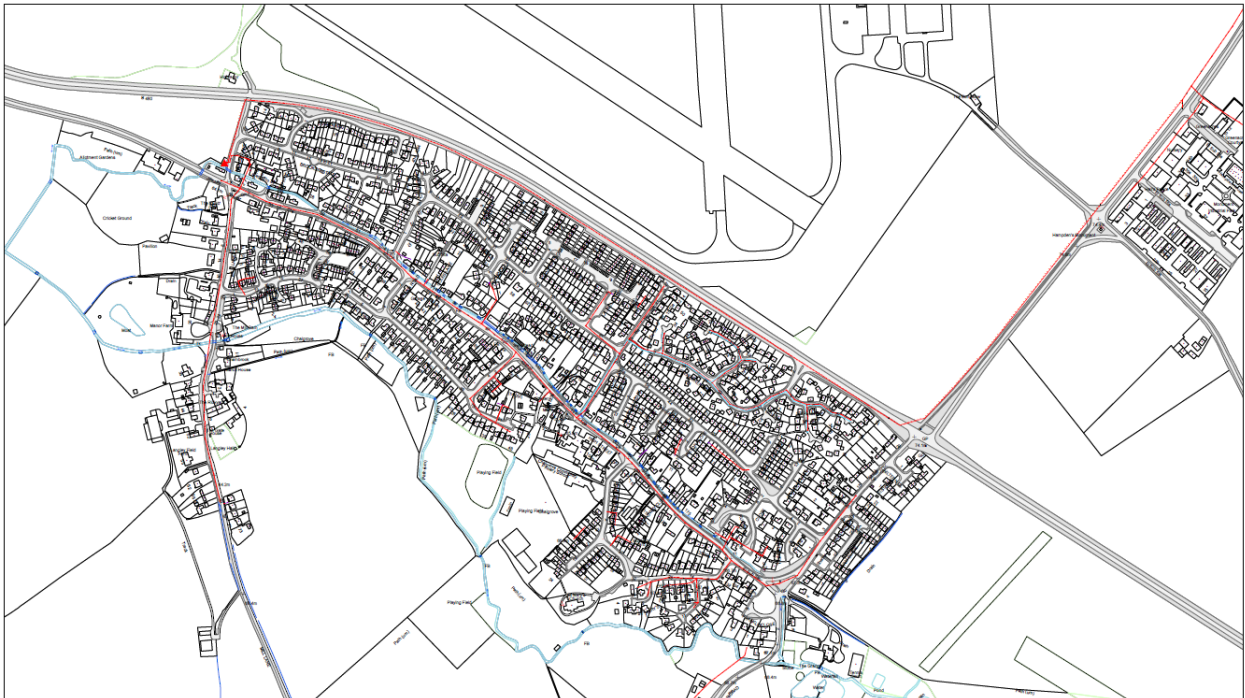


Figure 12 The location of sewers (red lines) in Chalgrove as provided by Thames Water.

Flood Risk Classification

Table 1 summarises the information which has been used in this study to classify the flood risk associated with different types of flooding.

Table 1. Flood Risk details

Type of Flood Risk	Risk Criteria	Details
River flooding	EA flood zone maps	The 1 in 100 year and 1 in 1000 year flood from designated main rivers
	Mapped historical flooding	Mapped extents of river flooding following recent flood events in Chalgrove (2008-2014) using photos, videos and observations
	Stream channels	The presence of channels flowing through or near to the development sites
Groundwater flooding	Soilscapes maps	Information on the soil drainage and likelihood of high groundwater
	Geology maps	BGS/EA maps showing the extent of aquifers and vulnerability to flooding
Surface water flooding	Surface water flood risk maps	Maps provided by the EA classifying the risk of surface water flooding
	Mapped historical flooding	Mapped extents of surface water flooding in Chalgrove from photos, videos and observational evidence
	GIS analysis	Delineation of natural flow pathways from digital terrain data
Water infrastructure flooding	Maps of water infrastructure	Locations of sewers, water mains and other infrastructure provided by Thames Water
	Flooding incidents	Records and locations of historical infrastructure flooding from Thames Water

The Assessment of Risk

The risk to each site was assessed based on an absolute and proportional risk rating system. To derive the risk the different flood risk classifications from the criteria listed in Table 1 were defined. These are presented in Table 2.

Table 2. Classification of the flood risk criteria

Risk Criteria	Classification
Flood Zone Maps	Within 1 in 100 year outline: high Between 1 in 100 and 1 in 1000 year outline: medium Outside 1 in 1000 year outline: low
Historical flooding (river and surface water)	Mapped historical flooding: high No mapped historical flooding: low
Stream channels	Stream channel flowing through or bordering the site: high No channel at the site: low
Soils maps	High groundwater/seasonally water-logged/ wet floodplain soils/poor drainage: high Moderate/ impeded drainage: medium Good drainage: low
Geology maps	High vulnerability: high Moderate vulnerability: medium Low vulnerability: low No aquifer: low
Surface water flooding maps	High and medium risk: high Low risk: medium Very low risk: low
GIS analysis	Presence of flow pathways: high No pathways: low Receiving area high density: high Receiving area low density: medium Receiving area rural: low

The absolute risk rating used a common EA approach where the worst case is always considered. This is also known as the precautionary approach in which basically the risk of a site as a whole is classed as the highest risk category to be found in that site. For example, if a only a small area of the site is shown to be within the 1 in 100 year outline, then the river flood risk is classified as high for the whole site. Alternatively, a proportional risk rating system was considered to give a more balanced assessment of the risk based on the area of the site affected. For example, if only 20 m² of a 10,000m² site were shown to be at high risk, there would still be plenty of land which could be developed at low risk. Therefore only the area shown at a particular risk rating was considered in the proportional risk classification. These are shown in Table 3.

Table 3. Classification for the area proportional risk

Area	Risk classification
More than 25% high risk (no medium risk)	High
More than 50% medium and high risk	High
More than 50% medium risk (no high risk)	Medium
Less than 25% high risk (no medium risk)	Medium
Less than 50% medium and high risk	Medium
Less than 25% medium risk (no high risk)	Low

The exceptions to the proportional classification are the presence of stream channels and the flow pathways. These were classified in terms of the length of channel or pathway in metres per hectare, as shown in Table 3. For the flow pathways the length referred to the actual length of the pathway within the site. For the stream channels, the length referred to the length both within the site and bordering the site. For many of the sites, one or more boundaries are made up by the Chalgrove Brook or minor water features.

Table 4. Classification for the proportional risk resulting from stream channels and flow pathways

Length (m/ha)	Risk Classification
More than 100	High
0 - 100	Medium
0	Low

A further risk index was added to the derivation of flow pathways, that was the nature of the receiving areas downstream of the site. If the flow was to a high density residential area, the risk was classified as high, for a low density residential area the risk was medium and for an entirely rural area the risk was classified as low. For those sites without any flow pathways, the risk was also classified as low. This risk classification is different from all the other risk indices as it is not defining the risk of flooding at the site but instead the risk of flooding from the site to other areas. Therefore it was not considered correct to combine this with the other risk indices but instead to include it as a separate score. There was also no way of considering a proportional risk classification as the risk was not confined to the area of the site itself.

Mapping Methodology

The identification of flood risk from all of the criteria listed above is possible through the use of GIS software. This enables the development sites to be overlain on the various flood risk data layers and for the proportional risk, the precise areas affected of each site can be calculated. The study has used the ArcGIS software package with the Spatial Analyst extension for grid cell based analysis. This is the most powerful and widely used GIS software and is very much accepted as the industry standard. Although GIS has very powerful mapping and graphical capability it also has the ability to provide attribute information associated with the spatial features. Therefore each feature whether it

is a point, line, polygon or grid cell has a range of data associated with it which makes GIS the ideal tool for such risk mapping rather than just a simple drawing package.

To quantify the risk assessment an overall score was attributed to the absolute and proportional risk classifications. This would allow for an easier comparison of the different sites and the different classifications used. The scoring was simply a value of 0 for low risk, 1 for medium risk and 2 for high risk. The scores for each site are given in the following sections, and then the scores are presented for all the sites in the summary.

The risk assessment methodology only considers the development sites in their current form and takes no consideration of the likely size or nature of the developments. A full assessment of risk should consider these components; however this is not possible at the current time and therefore the assessment is described as a strategic flood risk assessment. The key factor in considering the risk when a development is proposed for a given site, is that the level of detail provided by the developer and likewise the level of scrutiny imposed by statutory authorities such as the EA and Local Planning Authority, must be proportional to the size of the development. For example a development of 3-4 houses will have much less impact than a development of 30-40 houses, therefore much more detail should be provided for the larger development in terms of flood risk management.

South Oxfordshire District council provided estimates of the numbers of dwellings per site assuming a standard housing density of 25 dwellings per hectare, excluding areas of flood zones 2 and 3, and standard proportions of each site given for transport and amenity land. The number of houses is rounded to the nearest five and provided for each site. These values are solely for the purposes of demonstrating the potential size of the development and do not represent a proposed or required number of houses.

Site Flood Risk Assessments

The assessment of each site is presented in a separate section including a brief description of the site with photographs, then maps and discussions to demonstrate the risk from all of the criteria given in Table 2. The results of absolute and proportional risk classifications are tabulated, a total risk score is given from adding together the individual risk classification scores, and the risk to receiving areas and potential numbers of houses for each site are listed. The summary of the findings for all sites is given at the end of the report including Tables to allow a comparison of the flood risk scores for all of the sites.

1. Flood Risk at Site 1.

This is a roughly triangular 2.1 ha area of land situated at the western edge of the village between the High street, the B480 and Marley Lane (Figure 1.1 and 1.2). The land is under grass and periodically grazed by sheep.

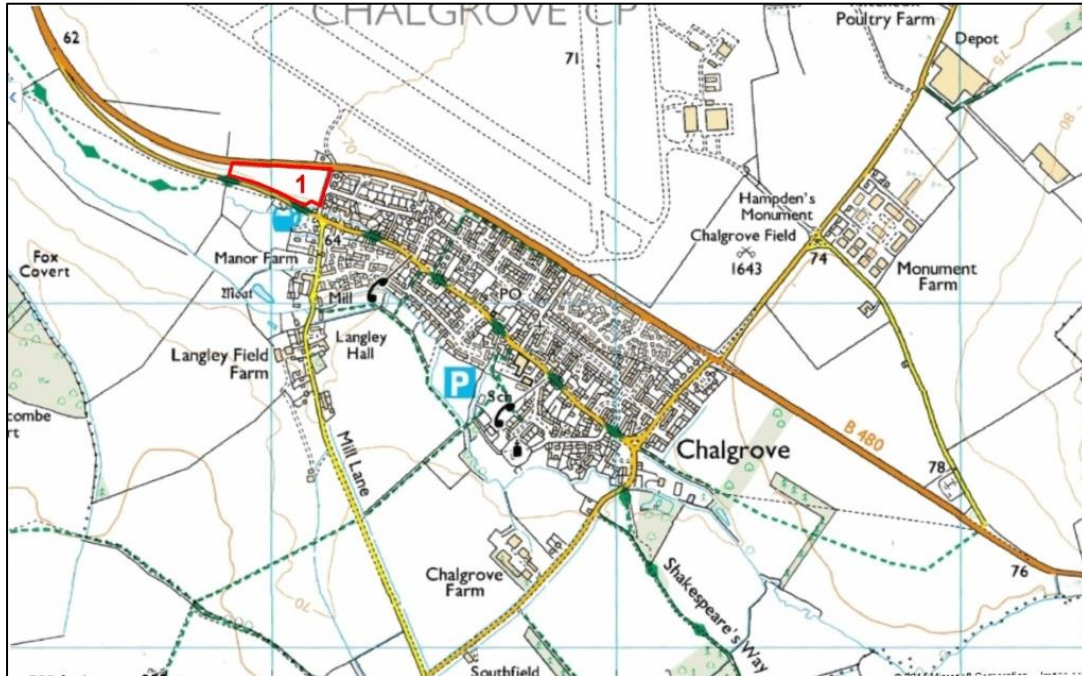


Figure 1-1 The location of site 1 (red outline)



Figure 1-2 Site 1 viewed to the west from Marley Lane

River flooding

The area is outside the EA flood zones although Marley Lane was flooded in June 2008 partly due to water originating from the High Street channel of the Chalgrove Brook, some of this water encroached onto the eastern edge of the site. The Chalgrove Brook flows along the south-eastern corner of the site.

Groundwater Flooding

The site is classified as free draining loam although the south-eastern part of the site is classified as minor aquifer with high vulnerability.

Surface Water Flooding

Areas along the High Street boundary are shown as high risk, surface water flooding has been observed at the site in the winter of 2014, and part of the flooding on Marley Lane was attributed to surface water. A large part of the B480 flooded in June 2008 which also encroached onto the site. Flow pathways are shown in the south-eastern corner of the site flowing towards residential areas and in the far western edge flowing towards agricultural land.

Flood Risk Scores for Site 1

Criteria	Absolute	Proportional
Flood zones	0	0
Stream channels	1	1
Historical flooding	1	0
Groundwater	2	0
Soil conditions	0	0
Surface water	2	1
Flow pathways	1	1
Total	7	3

Receiving areas risk: medium
Potential number of houses: 40 (SODC)

2. Flood Risk at Site 2

This is an area of undeveloped land on the western side of Mill Lane, to the south of the houses covering 0.87 ha, as shown in Figures 2.1 and 2.2.

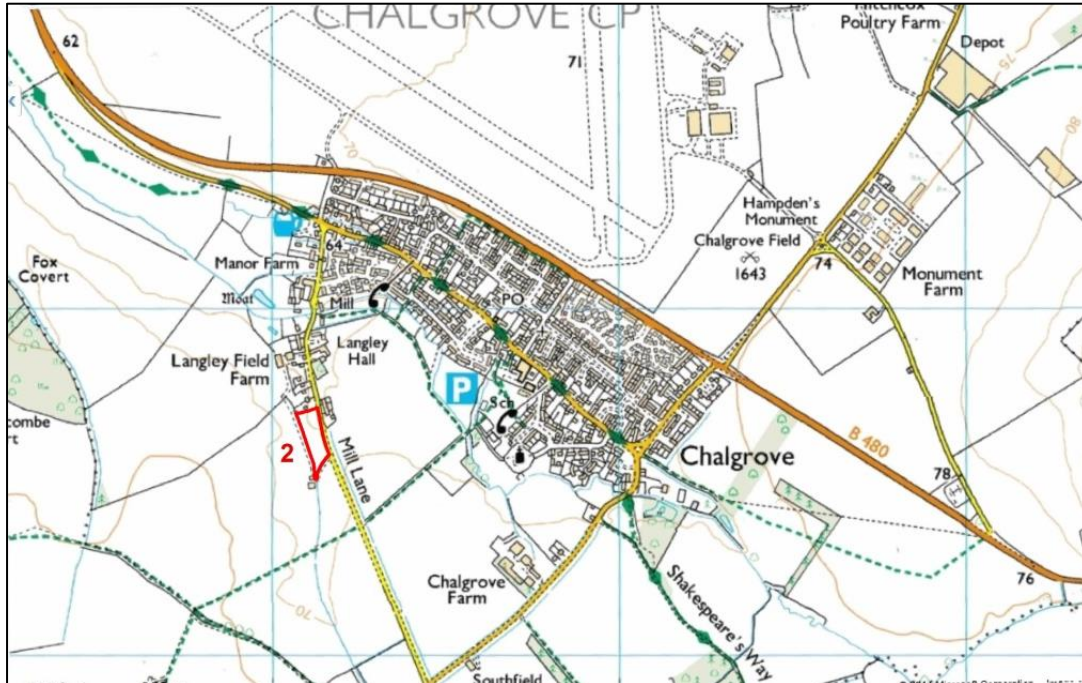


Figure 2-1 The location of site 2 (red outline)



Figure 2-2 Site 2 looking to the north from Mill Lane.

River Flooding

This site is outside of the EA flood zones and although it is bounded by a water course this is not designated as a main river therefore any flooding from the ditch would be classified as surface water.



Figure 2-3 The drainage ditch alongside site 2.

Groundwater Flooding

The site is on clay loam soils with impeded drainage but is underlain by impermeable Gault Clay with no risk of groundwater flooding.

Surface Water Flooding

The impermeable geology and poorly draining soils combined with lower ground levels than surrounding areas make the site at high risk of surface water flooding, as shown on the EA maps. The drainage ditch runs along the south-eastern and eastern boundary of the site and the flow pathways are shown to cross the site from south to north towards the residential area of Mill Lane.

Flood Risk Scores for Site 2

Criteria	Absolute	Proportional
Flood zones	0	0
Stream channels	1	2
Historical flooding	0	0
Groundwater	0	0
Soil conditions	1	1
Surface water	2	2
Flow pathways	1	2
Total	5	7

Receiving areas risk: medium
Potential number of houses: 20 (SODC)

3. Flood Risk at Site 3.

This is a large area of agricultural land situated between Mill Lane to the south-west and the main channel of the Chalgrove Brook to the north and east, covering an area of 13.2 ha (Figures 3.1 and 3.2). The field is normally used for arable farming, the south-east boundary defined by a footpath from Mill Lane to the Recreation Ground.

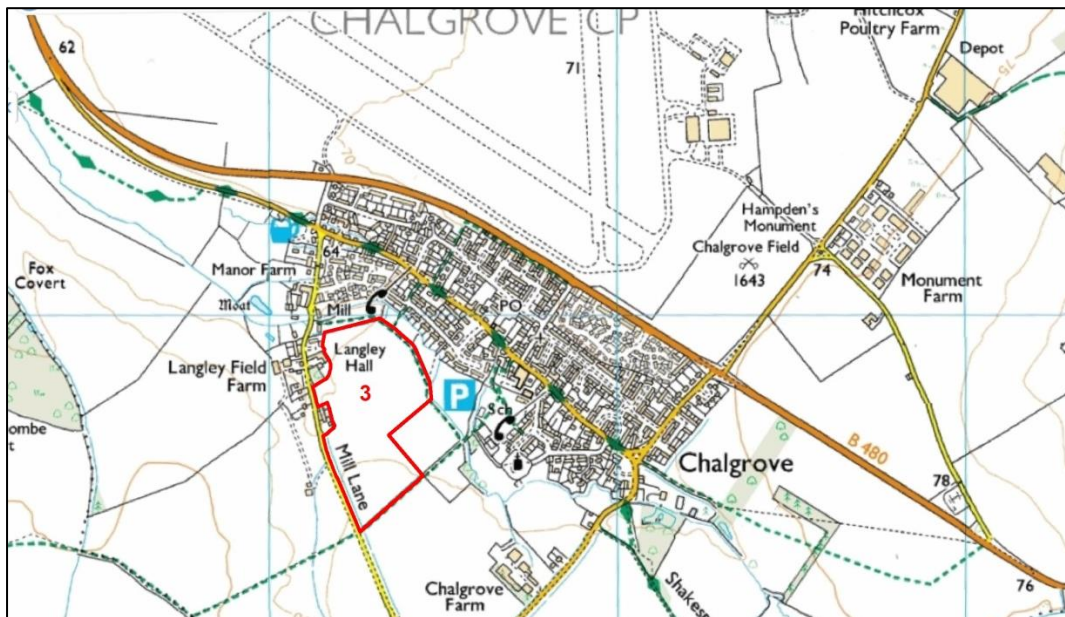


Figure 3-1 The location of site 3 (red outline).



Figure 3-2 Site 3 viewed from the south-eastern corner looking north-west towards the village.

River Flooding

As it borders the main channel of the Chalgrove Brook (Figure 3.3) the EA fluvial flood zones extend up to 200m into the northern part of the site. Floodwater was observed on parts of the site in January 2014. The site boundary also follows a side channel of the main Chalgrove Brook (Figure 3.4) which takes water from the Brook some 50m downstream of the footbridge reached by the footpath from Adeane Road and then returns it to the main channel via a culvert under Mill Lane.



Figure 3-3 The main channel of Chalgrove Brook on the northern boundary of Site 3.



Figure 3-4 The Chalgrove Brook side channel

Groundwater Flooding

The northern edge of the site includes areas of alluvium with a high vulnerability to groundwater flooding, and wet flood plain soils. The majority of the site is underlain by impermeable Gault Clay with clay loams soils and therefore not at risk of groundwater flooding. A small area of superficial gravel covers the southern corner of the site but these are classified as low risk.

Surface Water Flooding

The surface water flood risk maps show moderate areas of flood risk along the northern edge by the Brook and the western edge alongside Mill Lane. These areas are where surface water ponding has been observed in the winter of 2014, although the majority of the site has a low risk and despite the very high rainfalls during the 2014 winter it was not waterlogged. Apart from a flow pathway delineating part of the course of the main Chalgrove Brook channel, there is only a minor flow pathway shown in the western edge of the site flowing onto Mill Lane.

Flood Risk Scores for Site 3

Criteria	Absolute	Proportional
Flood zones	2	1
Stream channels	1	1
Historical flooding	1	0
Groundwater	2	1
Soil conditions	2	2
Surface water	1	0
Flow pathways	1	1
Total	10	6

Receiving areas risk: medium
Potential number of houses: 210 (SODC)

4. Flood Risk at Site 4.

This site occupies an area of land to the south of the village off the Berrick Road and bounded in the north-west by the Chalgrove Brook main channel (Figure 4.1). It covers an area of 3.1 ha and is currently a grass meadow (Figure 4.2) with part of the site used for horses.

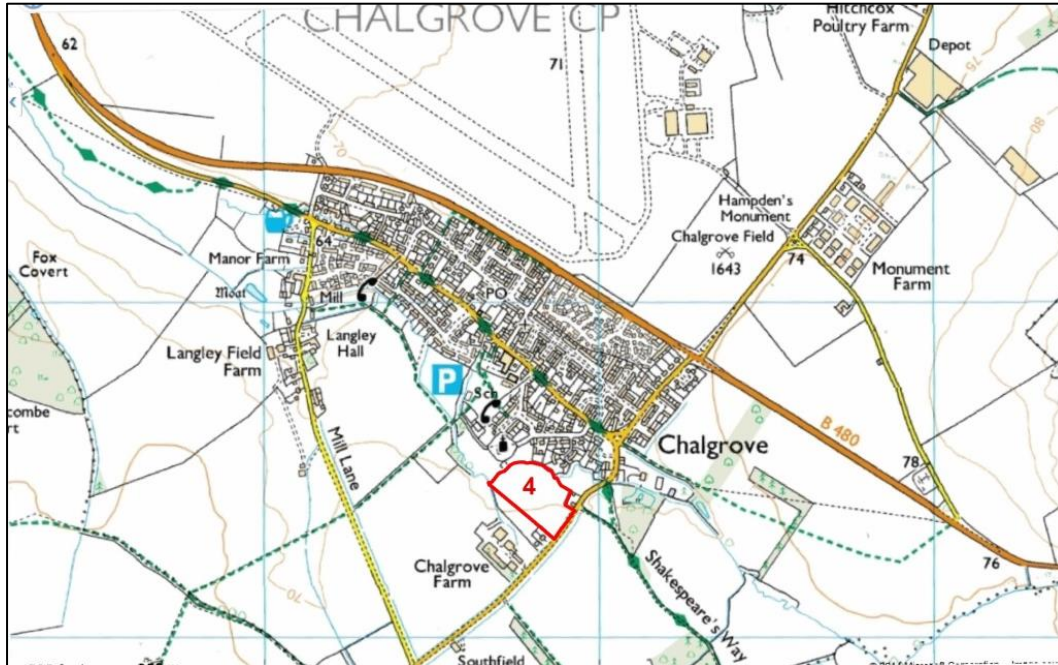


Figure 4-1 The location of site 4 (red outline).



Figure 4-2 Site 4 looking east from the Berrick Road.

River Flooding

The northern portion of the site is covered by the EA fluvial flood zones.

Groundwater Flooding

The northern part of the site is river alluvium with high vulnerability to groundwater flooding and wet floodplain soils. The rest is underlain by impermeable Gault clay with no risk of groundwater flooding.

Surface Water Flooding

The EA flood maps show the site is at low risk although the GIS analysis shows a flow pathway from the southern corner of the site across to the Chalgrove Brook.

Flood Risk Scores for Site 4

Criteria	Absolute	Proportional
Flood zones	2	1
Stream channels	1	1
Historical flooding	1	0
Groundwater	2	1
Soil conditions	2	2
Surface water	0	0
Flow pathways	1	2
Total	9	7

Receiving areas risk: low
Potential number of houses: 40 (SODC)

5. Flood Risk at Site 5.

Site 5 is a small area of land to the west of the Berrick Road just to the south of the main residential part of the village (Figure 5.1). It is bordered by the Chalgrove Brook main channel in the north and west, farmland to the south and Berrick Road to the east. It covers 0.86ha and is left as a meadow (Figure 5.2), sometimes grazed by sheep.

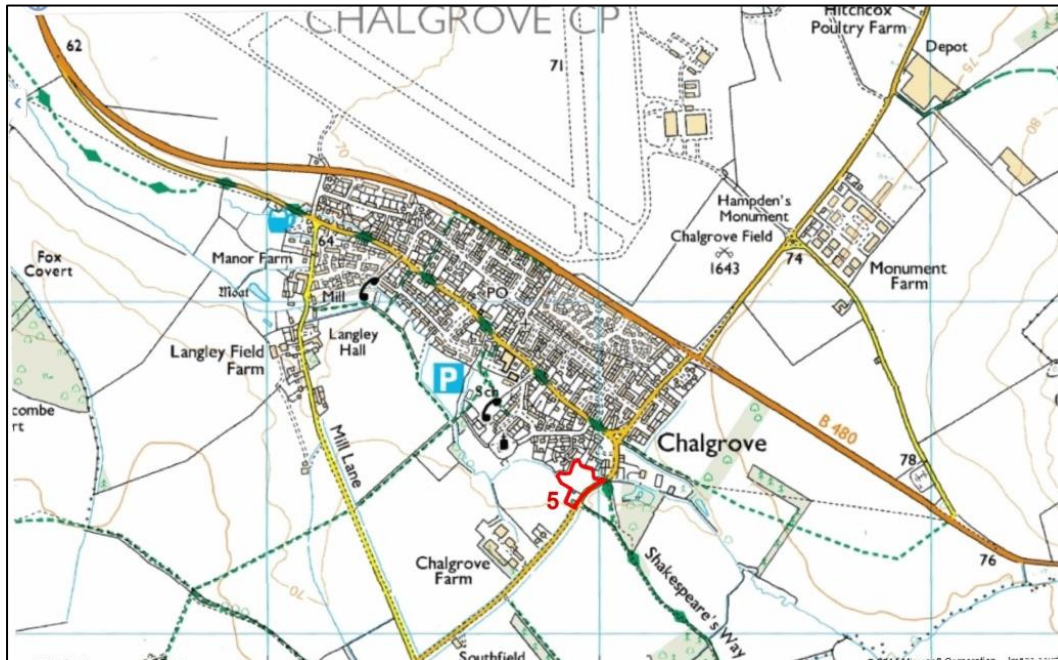


Figure 5-1 The location of site 5 (red outline).



Figure 5-2 Site 5 looking west viewed from the Berrick Road entrance.

River Flooding

A significant proportion of the site is in fluvial flood zones 2 and 3.

Groundwater flooding

Most of the site is underlain by river alluvium classified as having a high vulnerability to groundwater flooding with wet floodplain soils.

Surface Water Flooding

The surface water flood risk maps show moderate and high risk areas to the eastern side of the site and the Berrick Road was affected by surface water flooding over the winter of 2013/4. No flow pathways are shown on the site but the Berrick Road acts as a flow pathway along the western edge of the site.

Flood Risk Scores for Site 5

Criteria	Absolute	Proportional
Flood zones	2	2
Stream channels	1	2
Historical flooding	1	0
Groundwater	2	2
Soil conditions	2	0
Surface water	0	0
Flow pathways	0	0
Total	8	6

Receiving areas risk: low
Potential number of houses: 10 (SODC)

6. Flood Risk at Site 6

Site 6 is an area of land to the south east of the village bordered by Berrick Road to the west, the track to Cadwell Farm to the south, farmland to the east and the Chalgrove Brook to the north (Figure 6.1). It covers 2.3 ha and is currently used as a horse paddock (Figure 6.2).

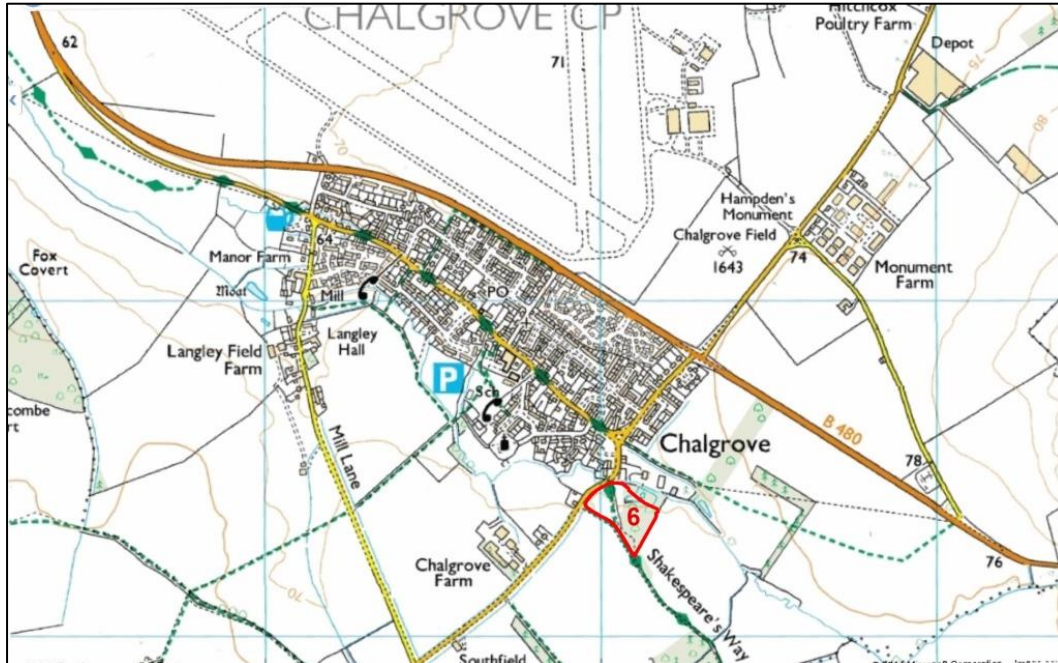


Figure 6-1 The location of site 6 (red outline).



Figure 6-2 Site 6 looking east from the Berrick Road.

River Flooding

Fluvial flood zones 2 and 3 encroach onto the northern margins of the site, where the site borders part of the Chalgrove Brook. The majority of the site is outside the fluvial flood risk areas.

Groundwater Flooding

Approximately half of the site is underlain by alluvium with a high vulnerability to groundwater flooding and with wet floodplain soils. The remainder is underlain by impermeable gault clay with no risk of groundwater flooding but with impeded drainage.

Surface Water Flooding

The EA maps show small areas at moderate to high risk along the northern edge of the site and in the south-western corner. During the winter of 2014 surface water was observed in the site and also for long periods in the Berrick Road bordering the site. The majority of the site is shown to be at low risk and the flow pathways do not pass through the site with the exception of a very small area in the north western corner.

Flood Risk Scores for Site 6

Criteria	Absolute	Proportional
Flood zones	2	1
Stream channels	1	1
Historical flooding	1	0
Groundwater	2	2
Soil conditions	2	2
Surface water	0	0
Flow pathways	0	0
Total	8	6

Receiving areas risk: low
Potential number of houses: 45 (SODC)

7. Flood Risk at Site 7

This is an area of arable land occupying 6.3 ha to the east of the village bordered by the B480 in the north, residential areas to the west and the Chalgrove Brook to the south (Figures 7.1 and 7.2).

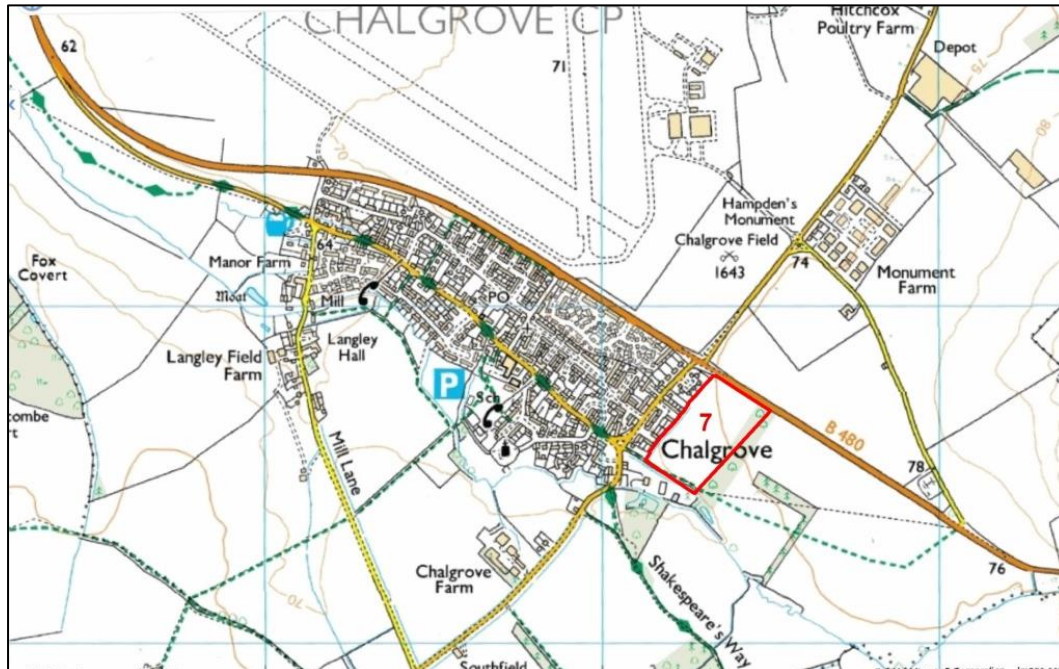


Figure 7-1 The location of site 7 (red outline).



Figure 7-2 Site 7 looking south from the corner of the High Street and the B480.

River Flooding

The site is only marginally encroached by the EA flood zones 2 and 3 along its southern boundary but the majority is a low risk.

Groundwater Flooding

The site is underlain by Gault clay but the northern half also includes superficial gravel deposits with an intermediate risk of groundwater flooding. The soils over the whole of the site are classified as free draining.

Surface Water Flooding

The site has a few areas shown to be at low risk of surface water flooding from the EA maps, with the majority classified as very low risk. No flow pathways are found over the site, one flow pathway in the northern half of the site is shown to originate at the edge of the site and flow westwards towards residential areas. The site is bounded to the west by a small drainage ditch (Figure 7.3) which is a non-main river and any flooding from this would be classified surface water flooding.



Figure 7-3 The drainage ditch on the western boundary choked with vegetation.

Flood Risk Scores for Site 7

Criteria	Absolute	Proportional
Flood zones	2	1
Stream channels	1	1
Historical flooding	0	0
Groundwater	1	1
Soil conditions	0	0
Surface water	0	0
Flow pathways	0	0
Total	4	3

Receiving areas risk: low
Potential number of houses: 125 (SODC)

8. Flood Risk at Site 8

This is a rectangular area of arable land located to the north of the village between the monument Road and Chalgrove Airfield covering 11.7 ha as shown in figures 8.1 and 8.2.

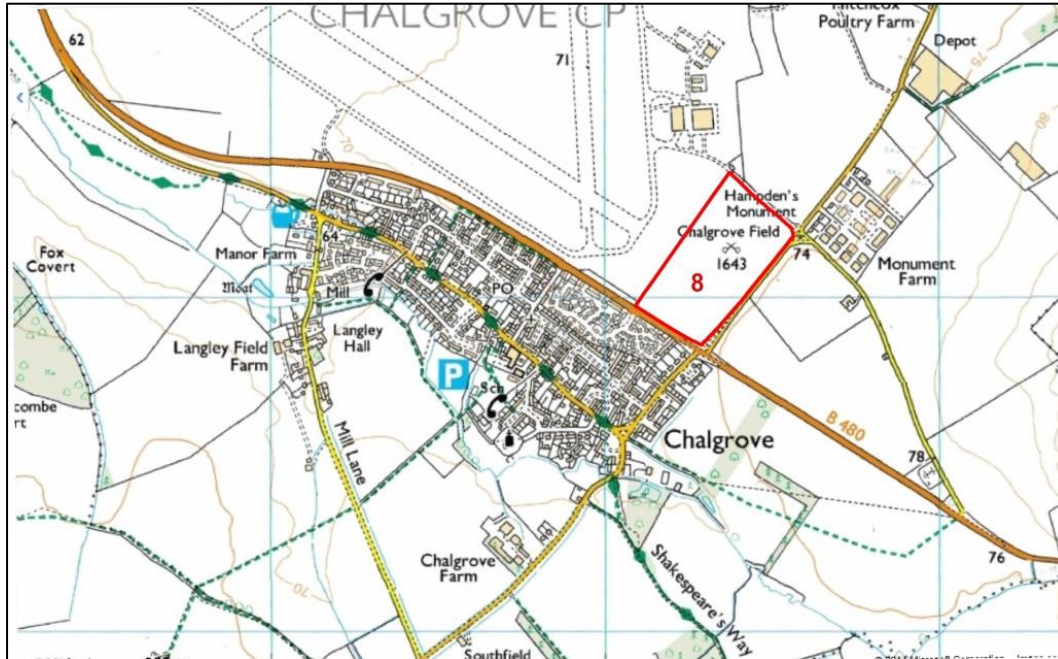


Figure 8-1 The location of site 8 (red outline).



Figure 8-2 Site 8 looking north from the corner of Monument Road and the B480.

River Flooding

Site 8 is a considerable distance (approximately 500m) from the main river therefore in the low risk flood zone.

Groundwater Flooding

The site is on Gault clay overlain by sand and gravel, which is classified as an intermediate risk of groundwater flooding. The soils are classified as free draining.

Surface Water Flooding

The EA flood maps show some small areas at low risk of surface water flooding but the majority of the site is at very low risk. Flow pathways are shown to cross the site from east to west and to originate from the site and flow in a westerly direction to Chalgrove airfield.

Flood Risk Scores for Site 8

Criteria	Absolute	Proportional
Flood zones	0	0
Stream channels	0	0
Historical flooding	0	0
Groundwater	1	1
Soil conditions	0	0
Surface water	1	0
Flow pathways	1	1
Total	3	2

Receiving areas risk: high
Potential number of houses: 215 (SODC)

9. Flood Risk at Site 9

Site 9 lies to the north-west of the village and is a roughly triangular area of arable land covering 14.7 ha bounded by Monument Road and the B480.

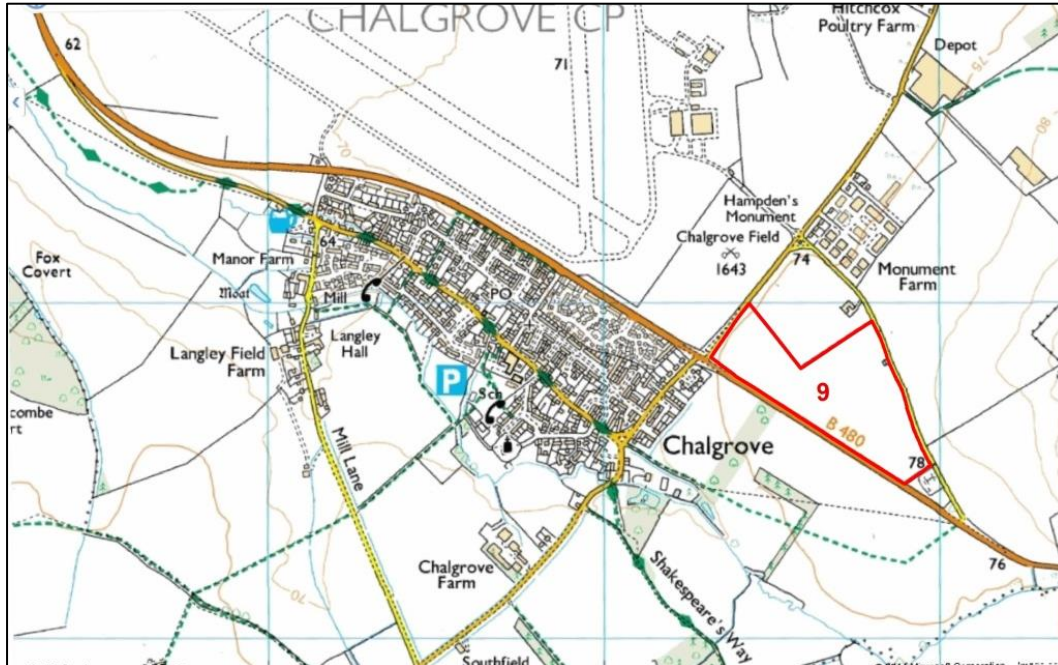


Figure 9-1 The location of site 9 (red outline).



Figure 9-2 Site 9 looking east from the corner of Monument Road and the B480.

River Flooding

Site 9 is a considerable distance (approximately 500m) from the main river therefore in the low risk flood zone.

Groundwater Flooding

The site is on Gault clay overlain in the west by sand and gravel, which is classified as an intermediate risk of groundwater flooding. The soils on the western half of the site are classified as free draining but areas of impeded drainage are found towards the east.

Surface Water Flooding

The EA surface water flood risk maps show some obvious areas of moderate risk of surface water flooding. The flow pathways also follow these areas with two separate pathways, one flowing in a north-westerly direction towards the Monument Business Park, another flowing north-west to start but then turning south-west towards the residential areas at the eastern entrance to the village off the B480.

Flood Risk Scores for Site 9

Criteria	Absolute	Proportional
Flood zones	0	0
Stream channels	0	0
Historical flooding	0	0
Groundwater	1	0
Soil conditions	1	1
Surface water	1	0
Flow pathways	1	1
Total	4	2

Receiving areas risk: **high**
Potential number of houses **270 (SODC)**

10. Flood Risk at Site 10

Site 10 is a small area of land covering only 0.13 ha on the western end of the village just past the Lamb public house and before the surgery (Figure 10.1). It was formerly the scout hut but is now an area of wasteland with the scout hut just used for storage of equipment rather than regular meetings (Figure 10.2).

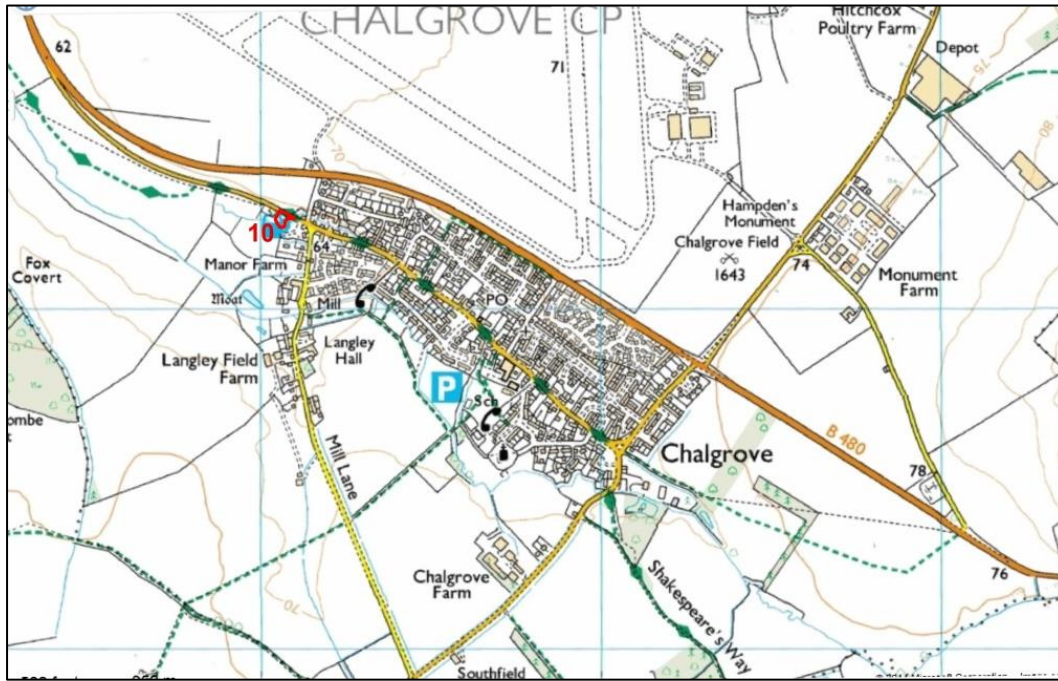


Figure 10-1 The location of site 10 (red outline).



Figure 10-2 Site 10 looking south from the High Street entrance.

River Flooding

The site is shown to be outside of the EA flood zone maps but it borders the High Street channel of the Chalgrove Brook and is near areas known to have flooded from this channel in 2008 and 2014.

Groundwater Flooding

The site is underlain by alluvium with a high vulnerability to groundwater flooding. Soil maps indicate the area to be free draining soils although this is where the soil and geology maps are not consistent. A better description of the soils would be wet floodplain soils.

Surface Water Flooding

The EA maps show the area to be at high risk of surface water flooding although the flow pathways do not pass through the site. The site is low lying and actually lower in altitude than the road surface so surface runoff from the road would flow onto the site.

Flood Risk Scores for Site 10

Criteria	Absolute	Proportional
Flood zones	0	0
Stream channels	1	2
Historical flooding	0	0
Groundwater	2	2
Soil conditions	0	0
Surface water	2	2
Flow pathways	0	0
Total	5	6

Receiving areas risk: low
Potential number of houses: 5 (SODC)

11. Flood Risk at Site 11

Site 11 covers 0.75 ha on the western edge of the village (Figure 11.1) and is currently the Chalgrove allotments as shown in Figure 11.2. The site is bounded by the High Street to the north, the High Street channel of Chalgrove Brook to the south, the surgery to the east and arable land to the west.

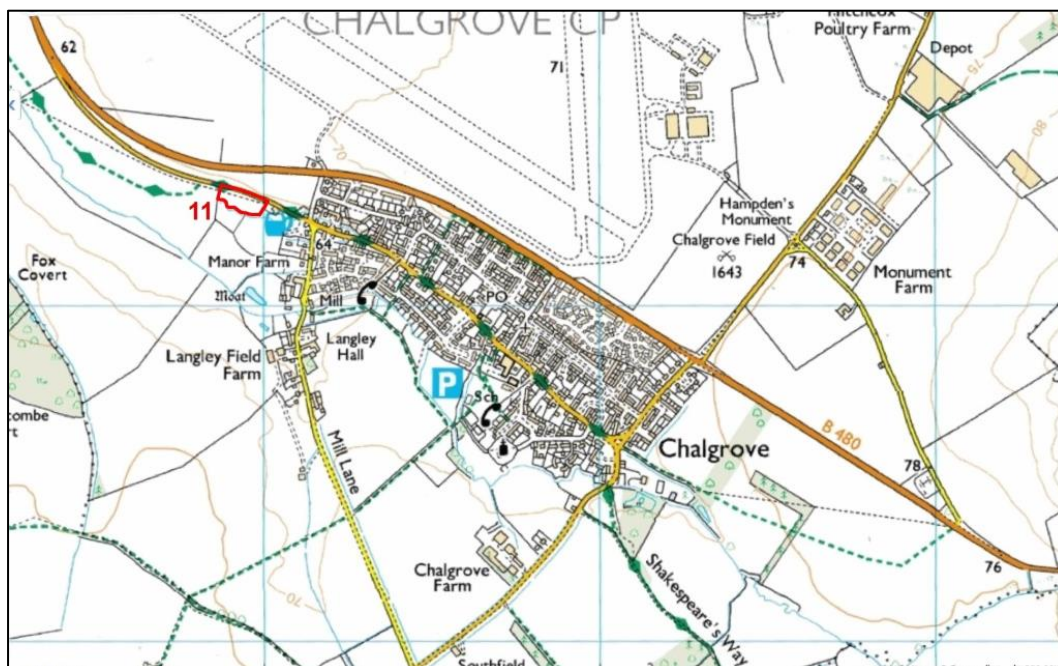


Figure 11-1 The location of site 11 (red outline).



Figure 11-2 Site 11 looking west from the surgery car park.

River Flooding

The site is shown to be outside of the EA flood zone maps but it borders the High Street channel of the Chalgrove Brook (Figure 11.3) and is near areas known to have flooded from this channel in 2008 and 2014.

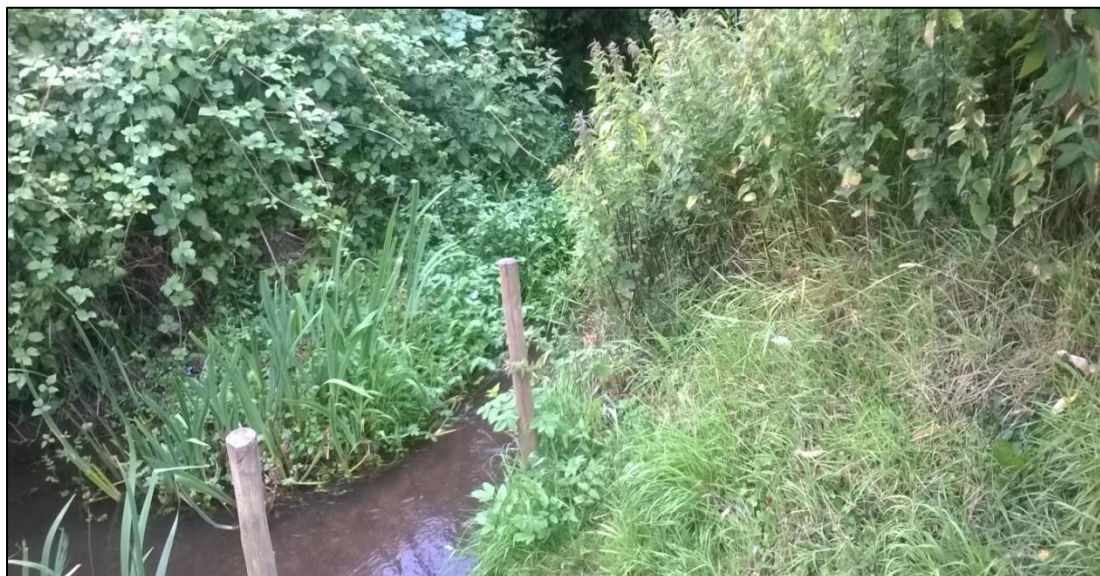


Figure 11-3 The High Street channel of Chalgrove Brook viewed from the allotments.

Groundwater Flooding

The site is underlain by alluvium with a high vulnerability to groundwater flooding. Soil maps indicate the area to be free draining soils although this is where the soil and geology maps are not consistent. A better description of the soils would be wet floodplain soils.

Surface Water Flooding

The EA maps show some moderate risk areas of surface water flooding in the south of the site but the majority of the site is very low risk. A flow pathway is shown to pass through the western side of the site flowing from north to south. Surface water flooding was observed on the High Street just to the west of the site in 2008 and 2014.

Flood Risk Scores for Site 11

Criteria	Absolute	Proportional
Flood zones	0	0
Stream channels	1	2
Historical flooding	0	0
Groundwater	2	2
Soil conditions	0	0
Surface water	1	0
Flow pathways	1	1
Total	5	5

Receiving areas risk: **low**
Potential number of houses: **15 (SODC)**

Summary of Flood Risk

The comparative flood risk across all 11 sites is presented in Summary Table 1. below which includes the risk attributed to each of the criteria for both the absolute and proportional risk scores. A combined score is also included which is the average of the absolute and proportional scores.

Summary Table 1. The flood risk scores for each site

Proportional Classification:											
Site	1	2	3	4	5	6	7	8	9	10	11
Flood zones	0	0	1	1	2	1	1	0	0	0	0
Stream channels	1	2	1	1	2	1	1	0	0	2	2
Historical flooding	0	0	0	0	0	0	0	0	0	0	0
Groundwater	0	0	1	1	2	2	1	1	0	2	2
Soil conditions	0	1	2	2	0	2	0	0	1	0	0
Surface water	1	2	0	0	0	0	0	0	0	2	0
Flow pathways	1	2	1	2	0	0	0	1	1	0	1
Total	3	7	6	7	6	6	3	2	2	6	5
Absolute Classification:											
Site	1	2	3	4	5	6	7	8	9	10	11
Flood zones	0	0	2	2	2	2	2	0	0	0	0
Stream channels	1	1	1	1	1	1	1	0	0	1	1
Historical flooding	1	0	1	1	1	1	0	0	0	0	0
Groundwater	2	0	2	2	2	2	1	1	1	2	2
Soil conditions	0	1	2	2	2	2	0	0	1	0	0
Surface water	2	2	1	0	0	0	0	1	1	2	1
Flow pathways	1	1	1	1	0	0	0	1	1	0	1
Total	7	5	10	9	8	8	4	3	4	5	5
Average Total Score	5	6	8	8	7	7	4	3	3	6	5

In terms of the absolute classification the highest flood risk score (10) is attributed to site 3, whereas under the proportional classification the larger area of site 3 means that it is not given the highest risk score. Instead sites 2 and 4 have the joint highest score of 7. When the absolute and proportional scores are averaged, sites 3 and 4 have the highest score of 8, followed by sites 5 and 6 on score 7 and sites 2 and 10 with a score of 6.

The preferred risk score is the proportional score since it takes the area of the sites into account which is important in terms of the potential for development because there is always the option to leave the more at risk areas of a site undeveloped and still have a significant area to build on. The scores given should not be used as a method to prevent development, as development is possible at all locations providing suitable measures are incorporated to reduce the risk of flooding to the building on the site and to neighbouring properties. The scores should however act as a guide to

ensure that proposals for development in areas of high risk have properly acknowledged the risk of flooding and have included sufficient detail on measures to reduce the flood risk.

The flood risk posed to receiving areas by the development site (as defined by the flow pathways) and the potential number of houses is shown in Summary Table 2. This shows especially that sites 8 and 9 with a potential for large numbers of homes and the flow from the site towards high density residential areas of Chalgrove, would require a detailed study of surface water management to accompany any planning application for development to ensure that the increase in surface water runoff from the impermeable surfaces of the new development will be effectively managed so as not to increase the risk of flooding in the receiving areas.

Summary Table 2. Receiving areas and potential house numbers for each site.

Site	Area (ha)	Risk to receiving area from flow pathways	Potential number of houses (SODC)
1	2.1	Medium	40
2	0.87	Medium	20
3	13.2	Medium	210
4	3.1	Low	40
5	0.86	Low	10
6	2.3	Low	45
7	6.3	Low	125
8	11.7	High	215
9	14.7	High	270
10	0.13	Low	5
11	0.75	Low	15

References

British Geological Survey 2014. Geology of Britain Viewer:
www.bgs.ac.uk/discoveringGeology/geologyOfBritain/viewer.html

Cranfield University 2014. Soil Scapes <http://www.landis.org.uk/soilscapes/>

Environment Agency 2014 What's in your backyard: <http://maps.environment-agency.gov.uk/wiyby/>

Annex 1. Flood Risk at the New Allotments Site

In the event of Sites 10 and 11 being developed, a proposal exists to create new allotments for the village as well as using part of the site for a Scout Hut. This site is adjacent to site 11, at the western edge of the village and is currently arable land. It covers an area of 2.04 ha and is bordered by the High Street to the north, the existing allotments and paddocks to the east and farmland to the west and the south. The Chalgrove Brook High Street channel forms the eastern boundary, for the area south of the existing allotments. In the south-eastern corner of the site this channel then meets the main channel of the Chalgrove Brook, and the single channel then forms the current boundary of the field. The proposed development area will however not extend all the way up to this channel but will remain some 20-30m distant. The location of the site in relation to the various flood risk indices is presented in the following figures A1-A7. Photos of the site and stream channels are shown in figures A8-A10.

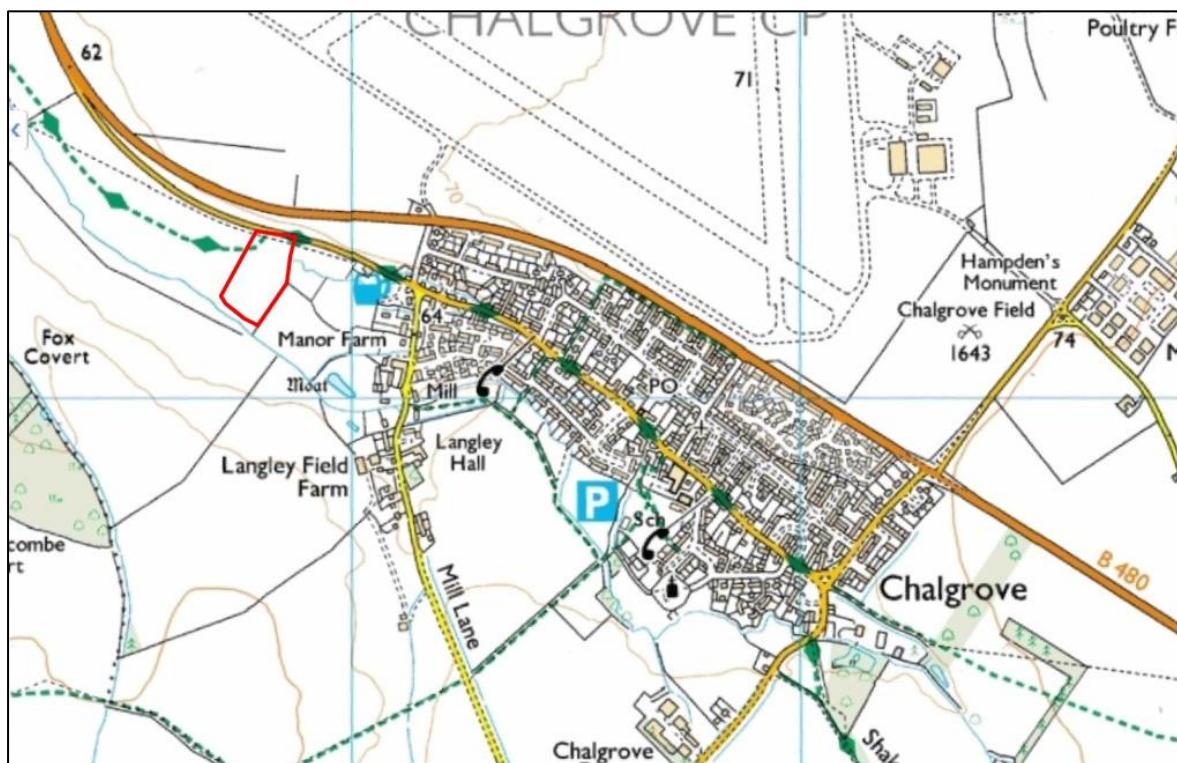


Figure A-1 The location of the site (red outline).

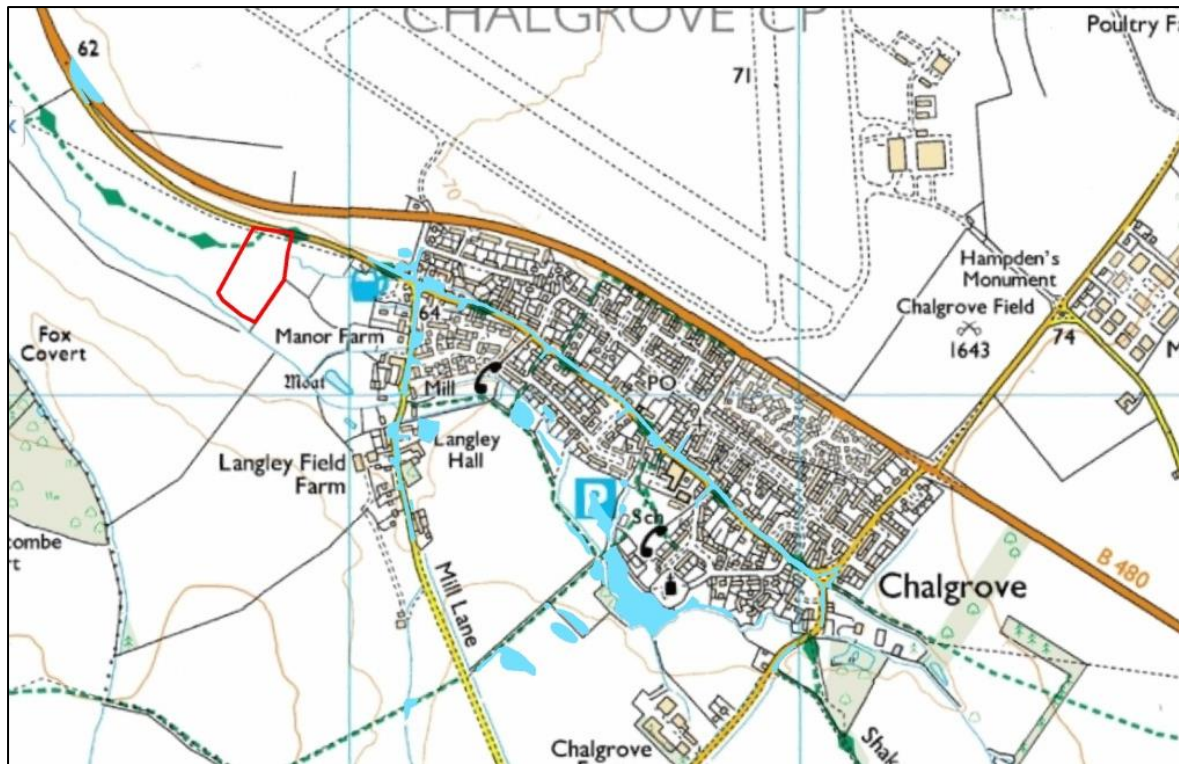


Figure A-2 Mapped historical flood outlines for Chalgrove.

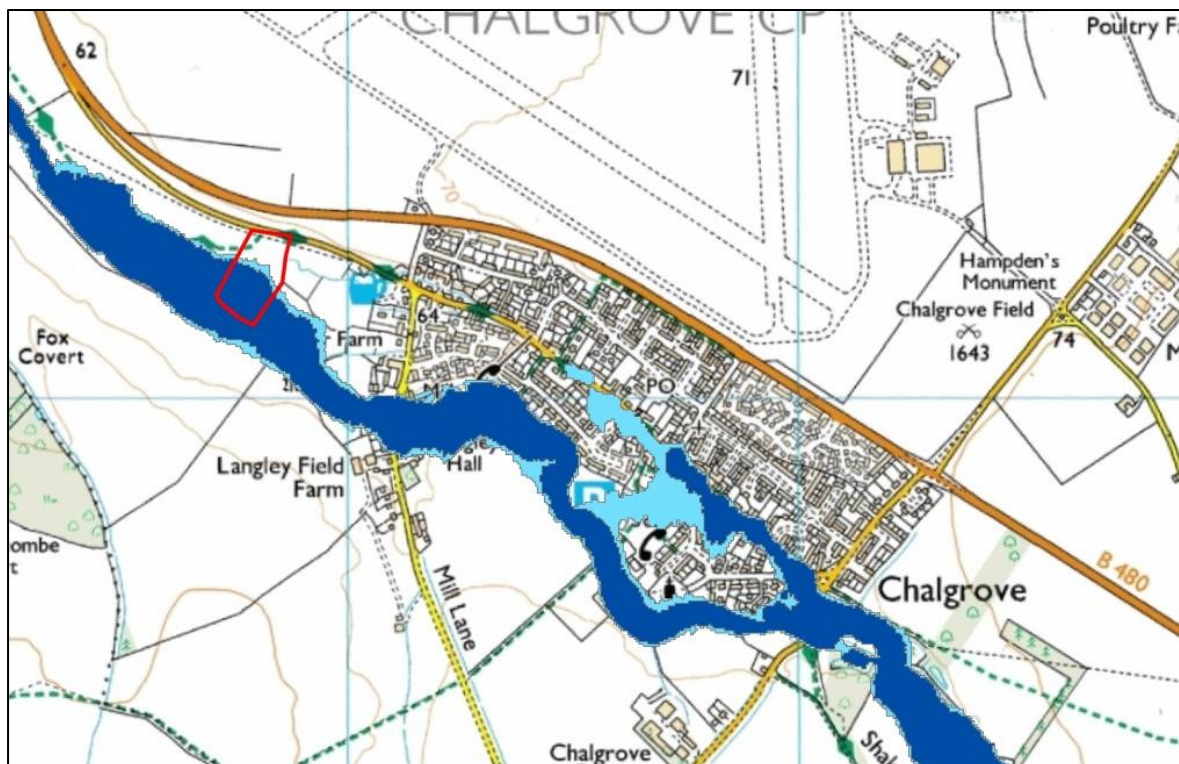


Figure A-3 The EA flood zones in relation to the proposed allotment site.

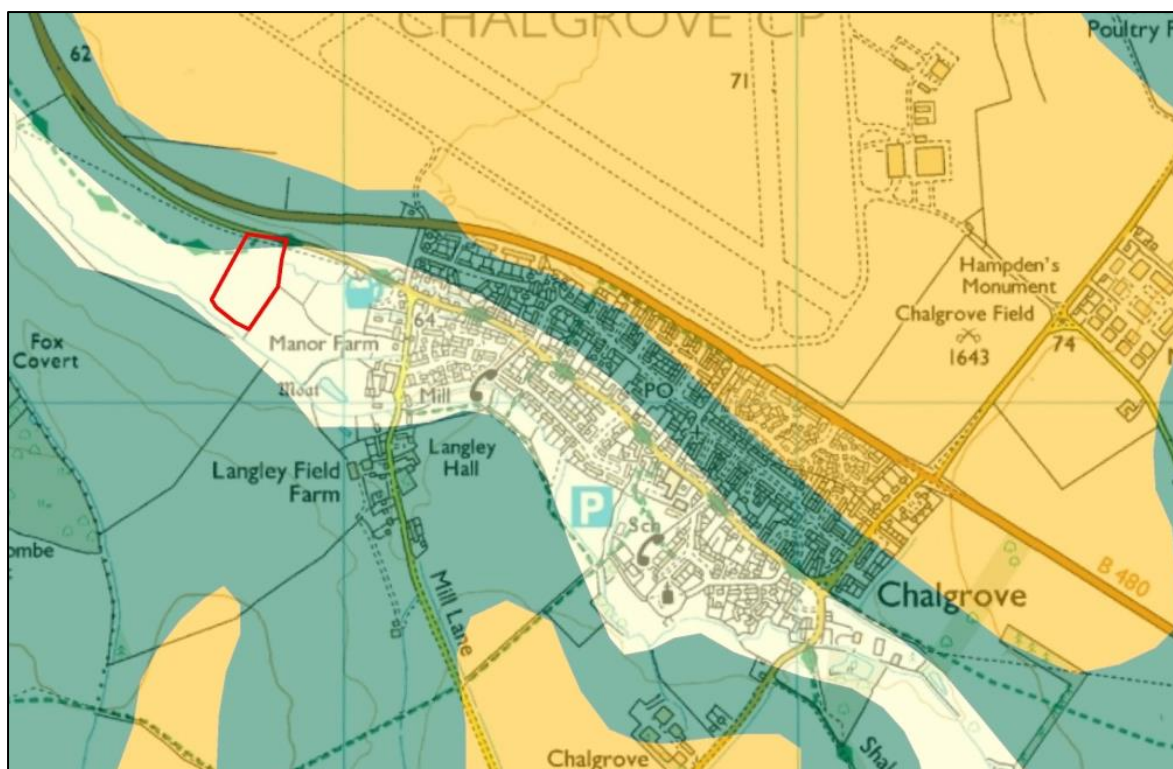


Figure A-4 Geology around Chalgrove: green: Gault clay; beige: Alluvium; orange Sandford and Radley Gravel Member (based on data from the BGS 2014).

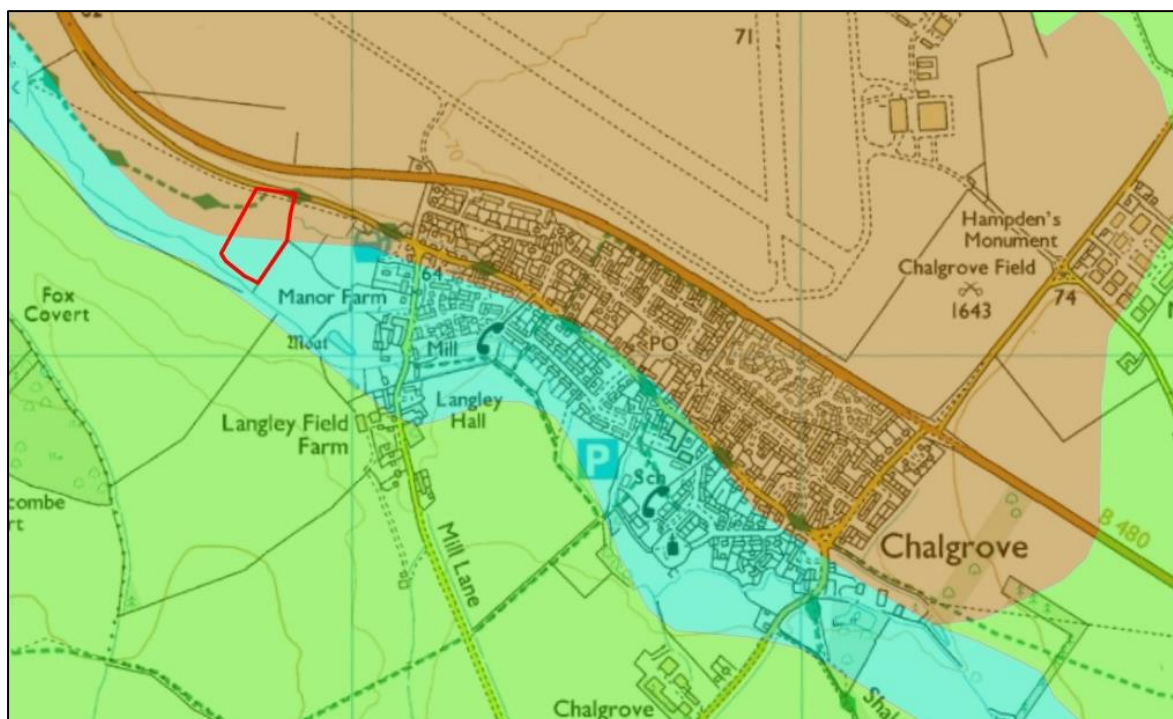


Figure A-5 Soils around Chalgrove: brown: free draining; blue: wet floodplain soils; green: impeded drainage.



Figure A-6 EA surface water flood risk maps for Chalgrove.

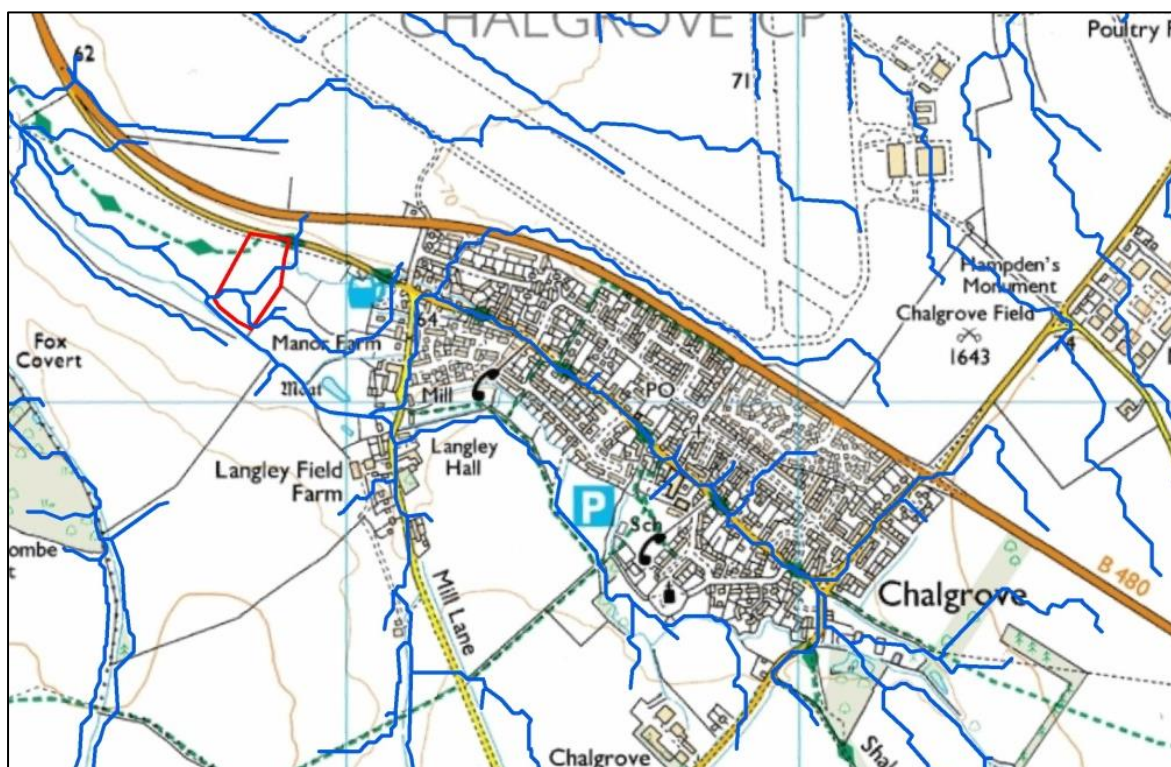


Figure A-7 Flow pathways around Chalgrove based on the DTM.

River Flooding

A significant proportion of the site is in fluvial flood zones 2 and 3 as the High Street channel of the Chalgrove Brook flows within 20m of the southern boundary of the site. The EA flood zone maps however do not include any inundation from the continuation of the High Street channel which forms most of the eastern boundary of the site. As the site is outside of the residential area of the village there is no photographic evidence of historical flooding at this site but anecdotal evidence suggests that there have been areas of water logging during the winter. Without any photographic evidence it was not possible to map areas of historical flooding at the site.

Groundwater flooding

Most of the site is underlain by river alluvium classified as having a high vulnerability to groundwater flooding with wet floodplain soils.

Surface Water Flooding

The surface water flood risk maps high risk areas through the centre of the site, certainly the site suffers from very wet soils during the winter.



Figure A-8 The proposed allotment site looking west from the existing allotments.



Figure A-8 The Chalgrove Brook High Street channel looking downstream along the eastern boundary of the proposed allotments.



Figure A-8 The Chalgrove Brook High Street/main channel confluence at the south-eastern corner of the proposed allotments.

Flood Risk Scores for the proposed allotment site

Criteria	Absolute	Proportional
Flood zones	2	2
Stream channels	2	1
Historical flooding	0	0
Groundwater	2	2
Soil conditions	2	2
Surface water	2	2
Flow pathways	2	2
Total	12	11

Receiving areas risk: low
Potential number of houses: n/a