JBA consulting

Berinsfield Neighbourhood Development Plan FRA

Draft Report

January 2015

Berinsfield Parish Council
c/o Clerk to the Council
Alchester Road
Chesterton
Bicester
OX26 1UN

Berinsfield Parish Council

JBA Project Manager

Ian Ringer
Crowmarsh Battle Barns
100 Preston Crowmarsh
Wallingford
Oxfordshire
OX10 6SL

Revision History

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Draft Report v1.0 (December 2014)		Annette Loveland (Berinsfield Parish Council Clerk)
Draft Report v1.2 (January 2015)	Section 4.4 included following meeting with Stuart Ely-Scott.	Annette Loveland (Berinsfield Parish Council Clerk)

Contract

This report describes work commissioned by Annette Loveland on behalf of Berinsfield Parish Council by a letter dated 18th September 2014. Berinsfield Parish Council's representative for the contract was Mr Stuart Scott-Ely, Chairman of the Berinsfield Neighbourhood Development Plan Steering Group. Ian Ringer and Elizabeth Gorton of JBA Consulting carried out this work.

Prepared by ..... Elizabeth Gorton BA
Assistant Analyst

..... Ian Ringer BSc, MSc, MCIWEM, C.WEM
Chartered Senior Analyst

Reviewed by ..... Paul Eccleston BA, CertWEM, CEnv, MCIWEM C.WEM
Technical Director

Purpose

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Executive Summary

Neighbourhood planning was introduced through the Localism Act 2011 and gives communities the power to shape and outline future development within their local area.

Berinsfield Parish Council have set up a Steering Group to consult the community and draft a Neighbourhood Development Plan (NDP). 25 sites within the Berinsfield Parish boundary have been put forward to be reviewed within the Berinsfield NDP with the aim of assessing which sites would be the most suitable and/or most preferred for development.

JBA Consulting were commissioned by the Steering Group in September 2014 to produce a Flood Risk Assessment (FRA) to support the NDP. The aim of this FRA document is to assess the current flood risk of each of the sites from fluvial, surface water, groundwater and sewer flooding. This assessment will directly feed into the NDP and provide potential developers with invaluable information on the flood risk of the land and the chances of being able to build on it before undertaking their own site specific FRA.

This FRA assesses all types of flood risk at each of the sites and gives an indication of the implications for development. General advice is given for planners and developers including:

- Permitted development within the Flood Zones and requirements for Flood Risk Assessments (FRAs) and applying the Sequential and Exception Tests
- Taking into account other sources of flooding
- Surface water runoff and drainage
- Making development safe

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Abbreviations and Definitions

Annual Event Probability	AEP	Expresses the probability of a flood event of a specific magnitude occurring in any one year. For example, the 1 in 100 year flood event is expressed as the 1% AEP; there is a 1% chance of it occurring within any given year.
Area Benefiting from Defence	ABD	Those areas which benefit from formal flood defences in the event of flooding from rivers with a 1% chance in any given year or from the sea with a 0.5% chance in any given year. If the defences were not there, these areas would be flooded.
Areas Susceptible to Groundwater Flooding	AStGWF	National map produced by the Environment Agency showing areas susceptible to groundwater emergence.
Brownfield		Brownfield (sites or land) is a term in common usage that may be defined as 'development sites or land that has previously been developed'.
Combined sewer overflow	CSO	In combined sewerage systems, foul drainage and surface water are conveyed in the same piped system. During rainfall, when flows in the combined sewer are high, excess flow is diverted to watercourses or ground in order to reduce the risk of combined sewer flooding. CSOs can be a significant source of pollution to watercourses.
Core Strategy	CS	Term no longer used to describe a Development Plan Document setting out the long-term spatial vision, strategic objectives and policies relating to future development of an area. Where they remain, the Core Strategy forms part of the Local Plan.
Digital Elevation Model	DEM	Digital Elevation Model is a digital model or 3D representation of a terrain's surface. There are three main sources of Dem data - LIDAR, Photogrammetry and InSAR. Where available LIDAR is preferred as it has a higher vertical accuracy.

Development Plan Documents	DPDs	Documents that make up the Local Plan and form part of the statutory development plan for the areas. DPDs must include the Local Plan and adopted Policies Map. All DPDs are subject to public consultation and independent examination.
Exception Test		Method to demonstrate that flood risk to people and property is managed whilst allowing necessary development to go ahead in situations where suitable sites of a lower flood risk are not available. The development must show that it will provide wider sustainability benefits to the community that outweigh flood risk, and that it will be safe for its lifetime, without increasing flood risk elsewhere and where possible reduce flood risk overall.
Flood Risk Management		The introduction of mitigation measures (or options) to reduce the risk posed to property and life as a result of flooding. It is not just the application of physical flood defence measures
Flood and coastal erosion risk management Grant in Aid	FCRMGiA	Central government funding to flood risk management authorities to pay for a range of activities including schemes that help reduce the risk of flooding and coastal erosion.
Flood and Water Management Act	FWMA	National legislation which places the responsibility of managing flood risk from main rivers, the sea and reservoirs with the Environment Agency and the responsibility of managing local sources of flood risk with lead local flood authorities.
Flood Map for Surface Water	FMfSW	National map produced by the Environment Agency showing flood risk from surface water at the 30 year and 200 year return periods. Updated in 2013 by the Updated Flood Map for Surface Water.
Floodplain		Any area of land over which water flows or is stored during a flood event or would flow but for the presence of defences
Flood Risk Assessment	FRA	A detailed site-based investigation that is undertaken by the developer at planning application stage
Flood Storage Area	FSA	Area designed to store water in a flood and release it later when flood waters have subsided.
Flood Zone		Areas of land at risk from tidal or fluvial flooding as delineated by the Environment Agency. Zone 1: Flooding predicted to occur less than once every thousand years (<0.1% Annual Event Probability) Zone 2: Flooding predicted to occur at least once every thousand years (0.1% Annual Event Probability) Zone 3: Flooding predicted to occur at least once every hundred years (1% Annual Event Probability)
Fluvial Flooding		Flooding caused by high flows in rivers or streams exceeding the capacity of the normal river channel.
Formal Defence		A flood risk asset which is maintained by any party to fulfil a flood defence function in agreement with the Environment Agency.
Functional Floodplain		An area of land where water has to flow or be stored in times of flood.
Greenfield		Greenfield (sites or land) is a term in common usage that may be defined as 'development sites or land that has not previously been developed'.
Historic Flood Map	HFM	National map produced by the Environment Agency showing historical flood extents.
Lead Local Flood Authority	LLFA	Body responsible for managing flood risk from localised sources across the County and a developing a strategy for local flood risk management that encompasses all sources of flooding (Oxfordshire County Council)
LIDAR		Light Detection and Ranging. An airborne laser mapping technique producing precise elevation data.
Local Plan	LP	The plan for the future development of the local area, drawn up by the local planning authority in consultation with the community. In law this is described as the development plan documents adopted under the Planning and Compulsory Purchase Act 2004. Current core strategies or other planning policies, which under the regulations would be considered to be development plan documents, form part of the Local Plan. The term includes old policies which have been saved under the 2004 Act.
Local Planning Authority	LPA	
Main River		Larger streams and watercourses, for which the Environment Agency is the designated body responsible for flood risk management.
Measure		A deliverable solution that will assist in the effective management (reduction) of risk to property and life as a result of flooding, e.g. flood storage, raised defence, effective development control and preparedness, and flood warning
Mitigation		The management (reduction) of flood risk
Neighbourhood	NDP	Parish and town councils can draw up a NDP. The NDP sets outs

Development Plan		policies and plans for the area, comparable to a Development Plan Document but on a very local scale.
National Planning Policy Framework	NPPF	The NPPF sets out the Government's planning policies for England and how these are expected to be applied at a local level.
OfWAT		The Water Services Regulation Authority. The economic regulator of the Water Industry in England and Wales.
Oxfordshire County Council	OCC	Lead Local Flood Authority covering both Districts.
Ordinary Watercourses		All watercourses other than Main Rivers. The Lead Local Flood Authority is the designated body responsible for flood risk management.
Probability	1%	A measure of the chance that an event will occur. The probability of an event is typically defined as the relative frequency of occurrence of that event, out of all possible events. Probability can be expressed as a fraction, % or a decimal. For example, the probability of obtaining a six with a shake of a fair dice is 1/6, 16% or 0.166. Probability is often expressed with reference to a time period, for example, annual exceedance probability
Residual Risk		The risk that inherently remains after implementation of a mitigation measure (option)
Return Period		The expected (mean) time (usually in years) between the exceedance of a particular extreme threshold. Return period is traditionally used to express the frequency of occurrence of an event, although it is often misunderstood as being a probability of occurrence.
Risk		The threat to property and life as a result of flooding, expressed as a function of probability (that an event will occur) and consequence (as a result of the event occurring)
Sequential Test		Sequential Test aims to steer new development into areas with the lowest probability of flooding. Flood Zone 1 should be considered first, and Flood Zones 2 and 3 should then be considered when there are no available sites within a lower flood risk. Within each flood zone, surface water and other sources of flooding also need to be taken into account in. The Exception Test should be applied if required.
Sewer		A pipeline, usually underground, designed to carry foul sewage and/or surface water from buildings and paved areas associated with buildings in more than one curtilage (plot of land).
Site Specific Allocations	SSAs	Allocation of sites for specific or mixed-use development.
South Oxfordshire District Council	SODC	
Strategic Flood Risk Assessment	SFRA	The assessment of flood risk on a catchment-wide basis for proposed development in a District
Sewage Treatment Works	STW	
Supplementary Planning Documents	SPD	Supplementary Planning Documents or SPD support DPDs in that they may cover a range of issues, both thematic and site specific. Examples of SPD may be design guidance or development briefs. SPD may expand policy or provide further detail to policies in a DPD. They will not be subject to independent examination.
Surface Water Management Plan	SWMP	Projects to investigate local flooding issues such as flooding from sewers, drains, groundwater, and runoff from land, small watercourses and ditches that occurs as a result of heavy rainfall. Carried out through a partnership of all relevant stakeholders including local authorities, internal drainage boards, sewerage undertakers and the Environment Agency.
Sustainable (Urban) Drainage System	SuDS	Current 'best practice' for new urban development that seeks to minimise the impact upon the localised drainage regime, e.g. through the use of pervious areas within a development to reduce the quantity of runoff from the site
SuDS Approving Body	SAB	Part of Schedule 3 of the Flood and Water Management Act (FWMA), which is yet to be fully commenced. The Act will establish SABs within LLFAs which will be responsible for approving, adopting and maintain SUDS that function or are built in accordance with new national standards for design, construction, operation and maintenance
Uncertainty		A reflection of the (lack of) accuracy or confidence that is considered attributable to a predicted water level or flood extent

Updated Flood Map for Surface Water	uFMfSW	National map produced by the Environment Agency showing flood risk from surface water as a result of the 1 in 30, 1 in 100 and 1 in 1000 year rain event.
Vale of White Horse	VOWH	
Water Framework Directive	WFD	European Union directive designed to improve and integrate the way water bodies are managed throughout Europe

1 Introduction

1.1 Background

The introduction of the Localism Act 2011 devolved more decision making powers from central Government into the hands of individuals, communities and councils. Neighbourhood planning provides communities with the power to shape and outline the developments within their local area by having a say on which developments should be built where and what they should look like.

The Neighbourhood Plan developed by Berinsfield Parish Council for the local area will be adopted by the South Oxfordshire Development Plan which will sit alongside the South Oxfordshire Local Plan. Planning permission within the Berinsfield Neighbourhood Development Plan (NDP) area will be assessed using both the Local Plan and Neighbourhood plans.

A Steering Group formed by Berinsfield Parish Council is composed of Parish Councillors and local people with an interest in the future of the village. The role of the Steering Group is to oversee the development of a draft neighbourhood development plan, consult with the community and hold a referendum within the village to vote on the NDP proposals. The plan is required to propose the minimum number of houses assigned by South Oxfordshire District Council within the Core Strategy as well as conforming to local and national planning policies.

25 sites within and surrounding Berinsfield have been put forward to be reviewed within the Berinsfield NDP with the aim of assessing which sites would be the most suitable and/or most preferred for development. JBA Consulting were commissioned by the Steering Group in September 2014 to produce a Flood Risk Assessment (FRA) to support the NDP.

The aim of this FRA document is to assess the current flood risk of each of the sites from fluvial, surface water, groundwater and sewer flooding. This assessment will directly feed into the NDP and provide potential developers with invaluable information on the flood risk of the land and the chances of being able to build on it before undertaking their own site specific FRA.

1.2 Neighbourhood plan objectives

Berinsfield is required to find space for new homes, shops and offices and is currently assigned 109[1] new houses within the SODC 2012 Core Strategy. The main aim of the Berinsfield NDP is to give the community a say in what these future developments will look like.

Producing a neighbourhood plan is not a requirement but a right which communities within England can choose to do. The benefits to Berinsfield for producing a neighbourhood plan include:

- Deciding where the new homes, shops, employment space and leisure facilities should be located
- Deciding what the new developments should look like
- Choosing what infrastructure should be provided alongside developments
- Setting planning policies to be used in determining planning applications
- Ability to grant planning permission through Neighbourhood Development Orders and Community Right to Build Orders for specific developments which comply with the orders
- Receiving 25% of the revenues from the Community Infrastructure Levy arising from development that takes place within Berinsfield NDP boundary

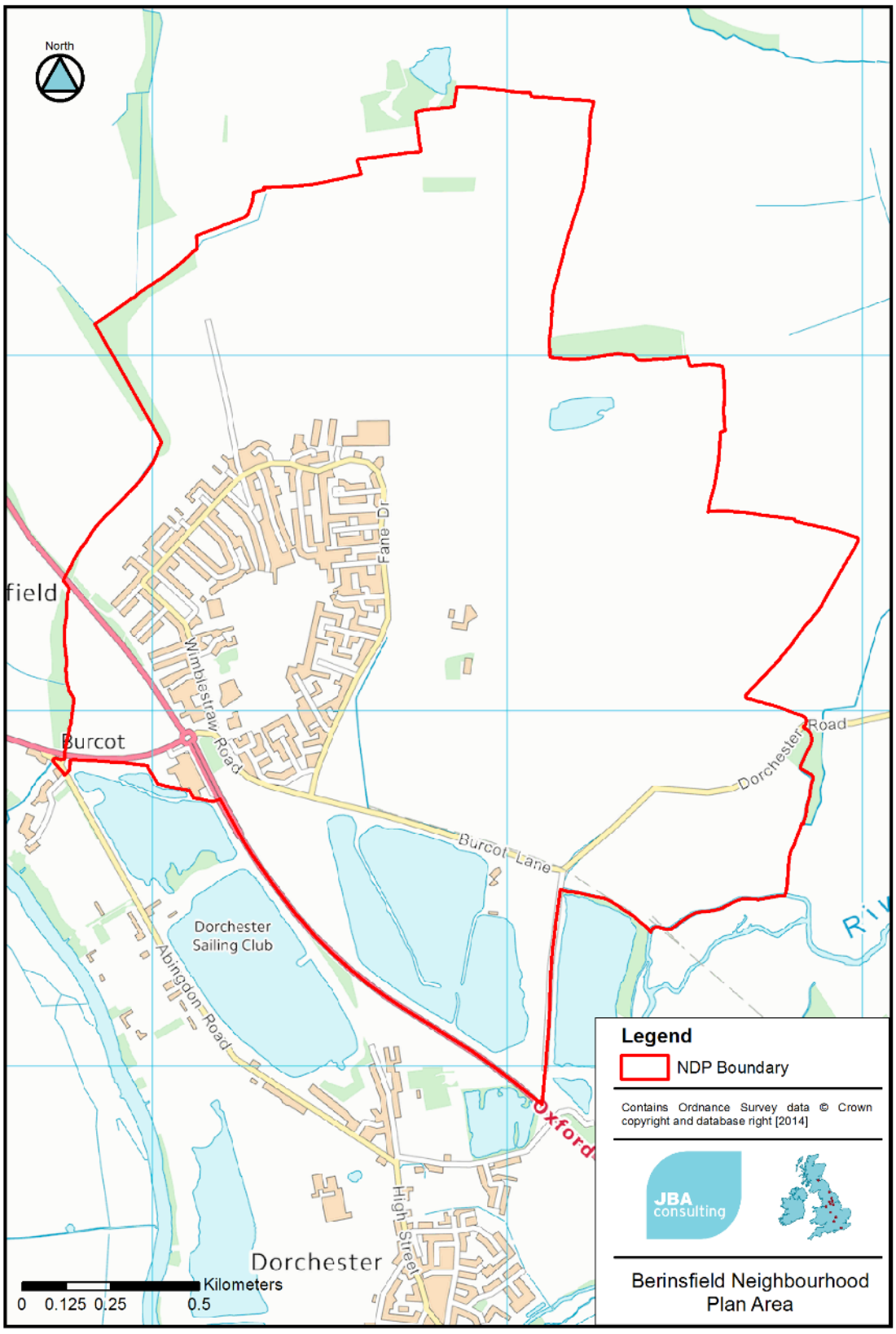
It is worth here noting that the recent Oxfordshire Strategic Housing Market Assessment (SHMAA), prepared in 2014 on behalf of all five Oxfordshire LPAs, recommends levels of housing growth in South Oxfordshire in the range of 725-825 homes per annum, compared to 547 in the Core Strategy. Consequently it is conceivable that SODC's emerging Local Plan may seek to increase the housing allocation for Berinsfield above the 109 homes identified in the Core Strategy.

1.3 Study Area

The boundary of the Berinsfield NDP was agreed with South Oxfordshire District Council to match the extent of the Berinsfield Parish Boundary. The study area is shown in Figure 1-1.

[1] Local Plan: Sites and General Policies Scoping http://www.southoxon.gov.uk/services-and-advice/planning-and-building/planning-policy/local-plan-sites-and-general-policies/loca

Figure 1-1: Berinsfield Neighbourhood Development Plan study area



2 Flood risk policy

2.1 Introduction

Planning policy and legislation with regards to development aims to ensure that flood risk is considered at every stage of the process.

Within South Oxfordshire the South Oxfordshire Development Plan alongside the National Planning Policy Framework and any other relevant national planning guidance determines the result of planning applications. The South Oxfordshire Development Plan consists of the Core Strategy, parts of the Local Plan and any adopted neighbourhood development plans.

2.2 National Legislation

2.2.1 Flood Risk Regulations (2009) and Flood and Water Management Act (2010)

The Flood Risk Regulations[2] place the requirements of the European Floods Directive[3] into UK law. The Flood Risk Regulation and Flood and Water Management Act[4] (FWMA) place the responsibility of managing flood risk from main rivers, the sea and reservoirs with the Environment Agency, lead local flood authorities (LLFAs) are responsible for managing local sources of flood risk.

The FWMA also requires the formation of SuDS Approving Body (SAB) within County Councils or Unitary Authorities. The SAB will be responsible for approving, adopting and maintain SUDS that function or are built in accordance with new national standards for design, construction, operation and maintenance. New and redeveloped sites will require SAB approval before construction can start. The implementation of the national standards has been delayed and, following a public consultation, Defra announced its intention in December 2014 to amend planning policy "so that local planning authorities could give increased weight to the provision and maintenance of sustainable drainage systems, alongside other material considerations, during the determination of a planning application." If this goes ahead, responsibility would lie with the local Planning Authority, in this case South Oxfordshire District Council. .

2.2.2 Water Framework Directive

The European Water Framework Directive[5] (WFD) came into force in 2000 and became UK law in 2003. It aims to improve the quality of water bodies within Europe. In England the Environment Agency is the lead authority although all parties involved in flood risk management or development proposals, from the LLFA to communities producing a neighbourhood development plans have a statutory duty to protect and address water quality issues within their area.

2.2.3 Localism Act

The Localism Act[6] was given Royal Ascent in November 2011 and shifted powers from Government to local councils and communities. The Act allows councils' to draw up their own development plans (section 2.3.2) and provide advice and support for communities to draw up neighbourhood plans. Neighbourhood plans are explained in section 2.4.1.

2.2.4 National Planning Policy Framework (NPPF)

The NPPF[7] was introduced in 2012, and supersedes the Planning Policy Statement 25: Development and Flood Risk (PPS25). The NPPF sets out the planning policies for England and promotes sustainable development in terms of economic, social and environmental roles. The NPPF provides guidance to help local planning authorities prepare local and neighbourhood plans.

[2]2009 No. 3042 Environmental Protection. The Flood Risk Regulations 2009.
http://webarchive.nationalarchives.gov.uk/20140328084622/http://www.legislation.gov.uk/uksi/2009/3042/contents/made
[3]Directive 2007/60/EC of the European Parliament and of the council of 23 October 2007
http://ec.europa.eu/environment/water/flood_risk/index.htm
[4] Flood and Water Management Act 2010 http://www.legislation.gov.uk/ukpga/2010/29/contents
[5] Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for the Community action in the field of water policy http://ec.europa.eu/environment/water/water-framework/index_en.html
[6] Localism Act 2011 http://www.legislation.gov.uk/ukpga/2011/20/part/6/chapter/3/enacted
[7]Department of Communities and Local Government (2012) National Planning Policy Framework
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/6077/2116950.pdf

Plans should take local circumstances into account and meet the development needs of the area to achieve sustainability.

Local plans should take account of flood risk from all sources and climate change over longer periods of time. Local Plans should be supported by a Strategic Flood Risk Assessment, taking advice from the Environment Agency and other flood risk management bodies, to manage flood risk.

Local Plans should apply a sequential risk based approach to the location of development if it is known to be at risk of any form of flooding. In terms of fluvial flood risk this means land within Flood Zones 2 and 3, or land within Flood Zone 1 with a critical drainage problem. The aim of the Sequential Test is to avoid developing in areas of flood risk by directing development to areas with the lowest probability of flooding. If it is not possible for the development to be located in a region of lower flood risk the Exception Test can be applied. To pass the Exception Test it must be shown that the development provides greater sustainability benefit to the community than is outweighed by the flood risk and a Site Specific Flood Risk Assessments demonstrates that the development will be safe for its lifetime and won't increase flood risk elsewhere. Where there is a residual flood risk to the development the residual risk to people and property should be reduced and managed.

Details of the Sequential Test and Exception Test are described within the NPPF and the accompanying NPPF Technical Guide[8]. The NPPF Technical Guide gives details on how to perform the tests.

2.3 County, district and catchment level policy

2.3.1 South Oxfordshire Strategic Flood Risk Assessment (SFRA)

The South Oxfordshire and Vale of White Horse SFRA[9] covering South Oxfordshire District Council (SODC) and Vale of White Horse District Council (VOWH) was published in July 2013. The document contains all the relevant flood risk information for the two District Councils to carry out the Sequential Test for site applications in order to locate development in areas of lowest flood risk. Fluvial, surface water, groundwater, sewer flooding, reservoir and other artificial sources of flooding were considered.

Flood risk for strategic sites and key settlements are discussed in detail and the implications for development within Berinsfield as a results of the flood risk assessment are as follows:

- Development should be sequentially located away from Flood Zones 2 and 3, meaning they would be most appropriate to the north and east of the village.
- Development should be sequentially located away from small watercourses. If a development allocation is proposed close to them, a FRA should be undertaken to understand the flood risk.
- Development must not increase the current surface water flood risk or flow paths.
- Thames Water should be consulted early in the development process to ensure sufficient capacity in the wastewater system and upgrades can be carried out where necessary.

The document also includes general guidance for planners and developers including:

- Permitted development within the Flood Zones and requirements for Flood Risk Assessments (FRAs) and applying the Sequential and Exception Tests
- Taking into account other sources of flooding
- Surface water runoff and drainage
- Making development safe
- River restoration and enhancement
- Existing watercourses, defences and assets
- Developer contributions to flood risk improvements
- The WFD and water quality

[8] Department of Communities and Local Government (2012) Technical Guidance to the National Planning Policy Framework https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/6000/2115548.pdf

[9] Strategic Flood Risk Assessment July 2013 http://www.southoxon.gov.uk/services-and-advice/planning-and-building/planning-policy/evidence-studies/district-flood-risk

2.3.2 South Oxfordshire Development Plan

The Development Plan[10] consists of two district wide planning documents, the Core Strategy and the Local Plan, as well as any adopted neighbourhood development plans. The Berinsfield neighbourhood development plan documents will eventually replace the South Oxfordshire Local Plan 2011.

2.3.3 South Oxfordshire Core Strategy (Part of the Local Plan)

The Core Strategy[11] was adopted in December 2012 and sets out the framework for development within South Oxfordshire up to 2027. The Core Strategy is one of five policy documents which make up the Local Plan. The strategy sets out what physical, social and green infrastructure is required within the region and by what means it will be delivered. The sections within the Core Strategy that specifically relate to flood risk management are described below.

14. The environment

It is recognised that development may impact the environment but that this impact should be reduced, specifically:

- Water quality - paragraph 14.11 states the Water Framework Directive requires there to be no deterioration in status of the water bodies.
- Flood risk management - paragraphs 14.12 and 14.13 describe the approach to flood risk management. They refer to the Strategic Flood Risk Assessment and NPPF guidance. The Strategic Housing Land Availability Assessment showed there was enough land within Flood Zone 1 within the district to meet the greenfield development allocation needs of the towns and villages. They "will not therefore need to look at zone 2 or 3 land for the built element of greenfield allocations or carry out any exception testing".

15. Quality development

This chapter sets out the Councils' objectives with regards to:

- Sustainable design and construction (Policy CSQ2) - including the need to adapt to higher temperatures and the need for water conservation and storage.
- Climate change adaption - paragraph 15.21 states that "new development should be designed to take account of such climate changes expected over the life of the development". Paragraph 15.24 recommends the use of SUDS to help cope with intense rainfall events.
- Design quality (Policy CSQ3) - developments should link to green infrastructure where available.

16. Green infrastructure and biodiversity

- Green infrastructure (Policy CSG1) - the Core Strategy aims to increase green infrastructure within South Oxfordshire through developments, developer contributions and other funding sources. Green infrastructure includes parks, woodland, amenity green space and outdoor sports facilities.
- Conservation and biodiversity (Policy CSB1) - the aim is to increase the net biodiversity within the District.

2.3.4 South Oxfordshire Local Plan

The South Oxfordshire Local Plan 2011[12] was adopted in January 2006 and formed the basis for planning decisions covering the period up until 2011. When the South Oxfordshire Core Strategy was adopted by the council in December 2012 it partially replaced a number of the policies within the South Oxfordshire Local Plan 2011. Policies that have not been replaced are still relevant. Policies of relevance to this FRA:

- Flood risk policy (EP5) was unsaved in 2008.
- Surface water protection policy (EP6) is still in use.

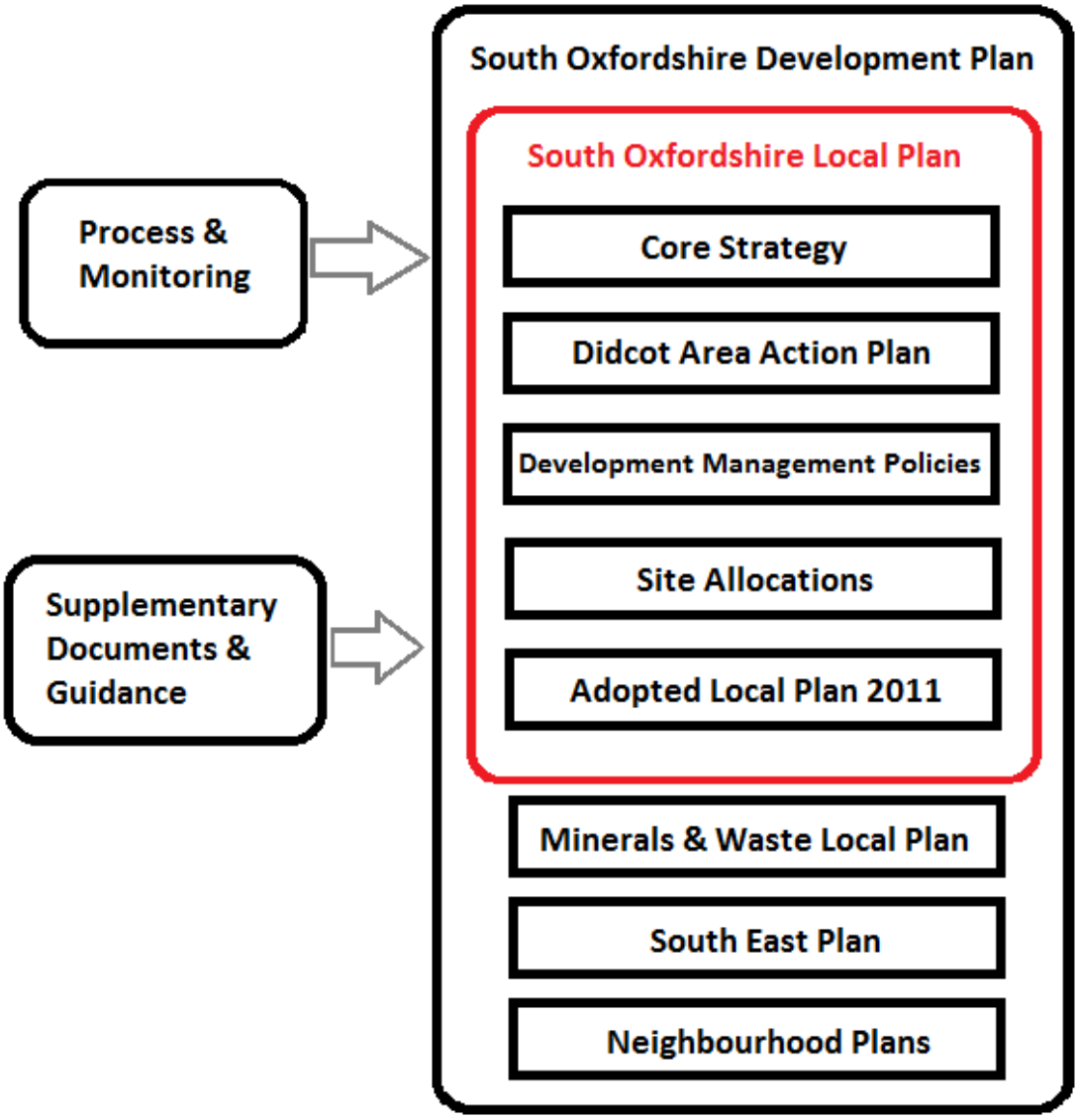
[10] South Oxfordshire Development Plan http://www.southoxon.gov.uk/services-and-advice/planning-and-building/planning-policy/our-development-plan
[11] South Oxfordshire District Council (December 2012) Core Strategy http://www.southoxon.gov.uk/services-and-advice/planning-and-building/planning-policy/core-strategy/adopted-core-strategy
[12] South Oxfordshire Local Plan 2011. Strike-through version on adoption of South Oxfordshire Core Strategy December 2012 http://www.southoxon.gov.uk/services-and-advice/planning-and-building/planning-policy/local-plan/local-plan-2011

- Developers must demonstrate that the surface water management system has been an integral part of the development design process, it has been developed in accordance with sustainable drainage principles and the surface water management system should mitigate any negative impacts from surface water run-off and flooding on people, property and the local environment.

- Groundwater protection policy (EP7) is still in use
  - Development with an adverse effect upon groundwater resources will only be permitted if preventative measures are taken to ensure the quality and quantity of the groundwater resources are maintained.

The South Oxfordshire Local Plan 2031 is currently in the development process.

Figure 2-1: Relationships of Plans in South Oxfordshire



2.3.5 Oxfordshire County Council Local Flood Risk Management (FRM) Strategy

Following the 2007 floods the Government gave local authorities the powers to manage local flood risk. The Flood and Water Management Act 2010 requires county councils to manage flood risk from surface water, groundwater and smaller watercourses within their area. Oxfordshire County Council have produced their local flood risk management strategy[13] which is currently in its draft stage.

[13] Oxfordshire County Council Draft Local Flood Risk Management Strategy Consultation 30 June 2014 - 19 September 2014 https://www.oxfordshire.gov.uk/cms/content/oxfordshire-local-flood-risk-management-strategy

The local flood risk management strategy sets out how Oxfordshire County Council will manage flood risk in the future.

2.3.6 Oxfordshire Preliminary Flood Risk Assessment

As Lead Local Flood Authority Oxfordshire County Council published a Preliminary Flood Risk Assessment (PFRA)[14] in June 2011. The PFRA is a broad scale assessment of past and future flood risk across the county. Analysis of data predicting future flood risk suggests that the level of flood risk is not significant to propose new Flood Risk Areas within Oxfordshire as defined by the Defra guidance (2010).

The PFRA used the Environment Agency guidance which states that 'unless an area identified as susceptible to groundwater flooding is also at risk from surface water flooding, it is unlikely that this location would actually experience groundwater flooding to any appreciable depth, and therefore it is unlikely that the consequence of such flooding would be significant'. Berinsfield had been identified by mapping as an area where a surface water flooding hotspot coincides with a greater than 75% chance of groundwater emergence and thus is an area at higher risk of combined groundwater and surface water flooding. The area most affected is in the south of the village. See Map 7 here https://www.oxfordshire.gov.uk/cms/content/oxfordshire-preliminary-flood-risk-assessment-pfra.

2.3.7 Thames Catchment Flood Management Plan (CFMP)

The Thames CFMP[15] was produced by the Environment Agency and adopted in 2008. It considers all inland flood risk within the River Thames catchment and sets policies for sustainable flood risk management for the whole catchment over the next 50 to 100 years.

The CFMP splits the catchment into sub-areas called policy units and each unit is given the most appropriate policy and flood risk management approach. Berinsfield sits within the Thame CFMP policy unit which has been assigned the policy P3. P3 means "areas of low to moderate flood risk where flood risk is currently being managed effectively".

2.3.8 Critical drainage areas and surface water management

Defra's Surface Water Management Plan Technical Guidance[16] indicates that the Lead Local Flood Authority (Oxfordshire County Council) have the leadership role in undertaking Surface Water Management Plans (SWMPs) if there is a need to do so, such as a history of surface water flooding or a development poses a risk to the existing drainage network or an opportunity to resolve an existing problem.

Berinsfield has not been classified as a critical drainage area and as such no SWMP covers the village currently.

2.4 Local Level policy

2.4.1 Neighbourhood Planning

Neighbourhood planning was introduced through the Localism Act (2011) and neighbourhood planning legislation came into effect in April 2012.

Neighbourhood planning gives communities the power to:

- make a neighbourhood development plan
- make a neighbourhood development order
- make a Community Right to Build order

Neighborhood development plans

A neighbourhood development plan provides communities the opportunity to direct and shape the development of their local area through general planning policies for development and use of land. It can steer where new homes and offices should be built, and what they should look like. The

[14]Oxfordshire County Council Preliminary Flood Risk Assessment June 2011
https://www.oxfordshire.gov.uk/cms/content/oxfordshire-preliminary-flood-risk-assessment-pfra
[15] Environment Agency (2008) Thames Catchment Flood Management Plan
http://webarchive.nationalarchives.gov.uk/20140328084622/http://cdn.environment-agency.gov.uk/geth1209bqyl-e-e.pdf
[16] Defra (March 2010) Surface Water Management Plan Technical Guidance
https://www.gov.uk/government/publications/surface-water-management-plan-technical-guidance

plan can be detailed or general but allows local people to get the right type of developments to meet the strategic needs and priorities of the region. The plan must still meet the needs of the wider area by taking account of the local councils' assessment of housing and other development needs.

A neighbourhood plan sits alongside the Local Plan prepared by the local planning authority and forms part of the development plan. Planning permission is granted using both the Local Plan and neighbourhood plan.

Communities which draw up a neighbourhood plan and receive the backing of the local people through a referendum, benefit from 25 percent of the revenues from the Community Infrastructure Levy arising from the development that takes place in their area.

Neighborhood development order

A neighbourhood development order allows the community to grant planning permission for development that complies with the order. It removes the need to submit planning applications to the local authority.

Community Right to build order

A Community Right to Build order grants planning permission to small-scale, site specific developments by a community group.

3 Risk based approach

3.1 How flood risk is assessed

3.1.1 Definitions

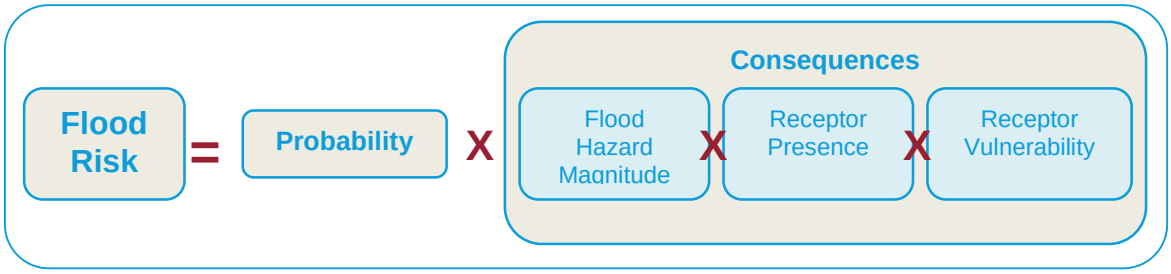
A flood is formally defined in the Flood and Water Management Act[17] as

"Where land not normally covered by water becomes covered by water and can be the result of water emanating from a number of sources".

Flood risk can be described as the combination of the statistical probability of a flood occurring and the scale of its potential consequences, whether inland or on the coast, and includes consideration of development located outside of the river and tidal flood risk areas. Thus it is possible to define flood risk as:

Flood risk = (probability of a flood) x (scale of the consequences)

On that basis it is useful to express the definition as follows:



The **probability** of flooding can be expressed as a return period in years (the average time between years with at least one larger flood), or as an annual exceedance probability (%) (the probability that a certain magnitude of flood will be exceeded in any one year).

Increasing the probability or chance of a flood being experienced increases the flood risk. In situations where the probability of a flood being experienced increases gradually over time, for example due to the effects of climate change, then the magnitude of the flood risk will increase.

The severity of the consequences can increase the flood risk:

- **Flood hazard magnitude:** If the direct hazard posed by the depth of flooding, velocity of flow, the speed of onset, rate of rise in flood water or duration of inundation is increased (for example due to the effects of climate change), then the consequences of flooding, and therefore risk, is increased. New development can potentially increase the hazard if it causes an increase in surface runoff flows.
- **Receptor presence:** The consequences of a flood will be increased if there are more receptors affected. Additionally, if there is new development that increases the probability of flooding or increased density of infrastructure then consequences will also be increased.
- **Receptor vulnerability:** If the vulnerability of the people, property or infrastructure is increased then the consequences are increased. For example, old people or children are more vulnerable if they are caught up in a flood event.

3.1.2 Using the FRA risk information

The FRA contains information on the risk of flooding from different sources of flooding. This information should be used for planning in advance of flooding. Should a flood event occur, the flood risk data should be reviewed and updated if necessary?

The NPPF sets out a sequential approach to steer new development to areas with the lowest probability of flooding. This is initially based on the Flood Zones, but should be refined by the FRA to take into account the probability of flooding, other sources of flooding and the impact of climate change.

[17] Flood and Water Management Act (2010) http://www.legislation.gov.uk/ukpga/2010/29/contents

The following sections describe the evidence base provided by available national flood risk mapping and other locally available flood risk information, to support the application of the sequential approach using the FRA.

3.2 Flood risk mapping

The following national mapping products were provided by the Environment Agency and SODC for the purpose of this FRA:

- Fluvial Flood Map
- Flood Map for Surface Water
- Historical Flood Event Outlines
- Defences
- Areas Benefiting from Defences
- Flood Storage Areas

3.2.1 Flood Map

The Flood Map is made up of a suite of GIS layers, including Flood Zone 2 and 3, Defences, Areas Benefiting from Defences and Flood Storage Areas.

The Flood Zones describe the land that would flood from rivers if there were no defences present. They are based on broad scale modelling that has been refined with detailed hydraulic models in areas of higher risk. Areas Benefiting from Defences can be identified using the accompanying layers.

A concept diagram showing the classification of Flood Zones graphically is included in Figure 3-1 below. Table 3-1 includes a description and discussion of appropriate development. A fuller discussion of Flood Zones and their relation to planning policy can be found in the NPPF and the technical guidance.

Figure 3-1: Definition of Flood Zones

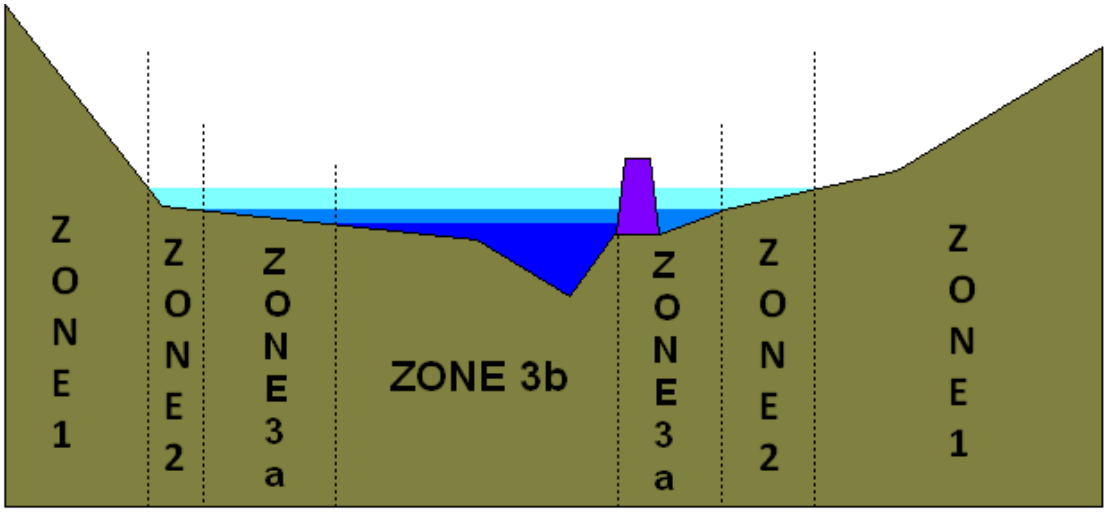


Table 3-1: Flood Zone descriptions

	Probability	Description	Suitable Development*
Zone 1	Low	This zone comprises land assessed as having a less than 1 in 1000 annual probability of river or sea flooding in any year (<0.1%).	All uses of land
Zone 2	Medium	This zone comprises land assessed as having between a 1 in 100 and 1 in 1000 annual probability of river flooding (0.1% - 1%) or between 1 in 200 and 1 in 1000 annual probability of sea flooding (0.1% – 0.5%) in any year.	Water compatible, less vulnerable and more vulnerable uses of land and essential infrastructure are appropriate. The highly vulnerable uses are only appropriate if the Exception Test is passed.
Zone 3a	High	This zone comprises land assessed	Water compatible and less vulnerable

	Probability	Description	Suitable Development*
		as having a greater than 1 in 100 annual probability of river flooding (>1.0%) or a greater than 1 in 200 annual probability of flooding from the sea (>0.5%) in any year.	uses of land are appropriate. More vulnerable and essential infrastructure should only be permitted if the Exception test is passed. Highly vulnerable uses should not be permitted.
Zone 3b	Function Floodplain	This zone comprises land where water has to flow or be stored in times of flood. SFRAs should identify this Flood Zone (land which would flood with an annual probability of 1 in 20 (5%) or greater in any year or is designed to flood in an extreme (0.1%) flood, or at another probability to be agreed between the LPA and the Environment Agency, including water conveyance routes.	Water compatible and essential infrastructure that has to be there is permitted. Essential infrastructure should pass the Exception Test and be designed and constructed to meet a number of flood risk related targets. Less vulnerable, more vulnerable and highly vulnerable uses should not be permitted.

New development should, whenever possible, be placed in Flood Zone 1. The Flood Zones are indicative of the potential undefended floodplain. Allocating sites in Flood Zone 1 means that future development is not reliant on fluvial or coastal flood defences. This negates the requirement of committing future generations to costly long term expenditure, which becomes unsustainable in light of the effects of climate change.

However, developers should be aware that the runoff from development on Flood Zone 1 land can potentially cause an increase in the probability of flooding.

The most up to date version of the Flood Map should always be used, and can be viewed at http://www.environment-agency.gov.uk/homeandleisure/37837.aspx.

If it has not been possible for all future development to be situated in Flood Zone 1, or away from areas at flood risk from other sources, then a more detailed assessment is needed to understand the implications of locating proposed development in Flood Zones 2 or 3. It may be necessary to apply the Exception Test (see Table 3-1), in which case the scope of the site specific FRA must be expanded to take into account the 'actual' and 'residual' risk considering the presence of flood risk management infrastructure and its effect on the frequency, impact, speed of onset, depth and velocity of flooding.

3.2.2 Functional floodplain

The 'functional floodplain' is defined as an area of land where water has to flow or be stored in times of flood. This forms Flood Zone 3b in terms of the NPPF. Within the SODC and VOWH SFRA, the functional floodplain was defined as:

- The 1 in 20 year modelled flood extent wherever hydraulic models are available (River Thames)
- Elsewhere, take a precautionary approach and assume that Flood Zone 3a represents the functional floodplain (Elaine's Ditch and Burcot Brook)

Flood Zones 3a and 3b are collectively referred to as Flood Zone 3.

3.2.3 Climate change

The Environment Agency Flood Map layers do not include a layer for climate change impact. Some sensitivity testing was undertaken in 2007 to determine the impact of a 20% increase in flows to represent climate change (as recommended by the NPPF Technical Guidance on the Flood Zones), and it was found that on most watercourses the impact was relatively minor.

Within the SODC and VOWH SFRA the Districts and Environment Agency agreed that:

- The 1 in 100 year plus 20% climate change modelled flood extent should be used wherever hydraulic models are available (i.e. River Thames model).
- Elsewhere, take a precautionary approach and assume that the Flood Zone 2 outline represents Flood Zone 3 with climate change.

3.2.4 Surface water mapping

Lead Local Flood Authority (with in the PFRA) stated that the Environment Agency's Flood Map for Surface Water (FMfSW) should be used for assessing surface water risk in Oxfordshire (termed 'locally agreed' surface water information). The SFRA used this information in line with the PFRA.

Since the SFRA was published in 2013 the FMfSW has been updated and new mapping referred to as the Updated Flood Map for Surface Water (uFMfSW) which is used in this assessment.

The type of flooding shown by the uFMfSW fits with the definition of 'surface water' defined within the Flood and Water Management Act (2010) and shows the flooding that takes place from the 'surface runoff' generated by rainwater (including snow and other precipitation) which:

(a) Is on the surface of the ground (whether or not it is moving), and

(b) Has not yet entered a watercourse, drainage system or public sewer.

The 2012 FMfSW was a new national scale surface water flood mapping for England and Wales. It improved on the previous national scale surface water flood maps by including more local information supplied by LLFAs and using better data and modelling techniques. Local information which was supplied by the LLFAs, such as drainage rates, percentage runoff rates and critical storm durations was also used within the modelling. The uFMfSW produced in 2013 aimed to provide the best single source of information on surface water for England and Wales by drawing together:

- The Environment Agency's national scale surface water flood mapping, and
- Appropriate locally produced mapping from LLFAs

The uFMfSW picks out natural drainage channels, rivers, low areas in floodplains, and flow paths between buildings. But it will only indicate flooding caused by local rainfall. It does not show flooding that occurs from overflowing watercourses, drainage systems or public sewers caused by catchment-wide rainfall events or river flow. It is therefore important users apply local knowledge to assess how suitable the updated Flood Map for Surface Water is for their needs.

To meet the requirement so of the Flood Risk Regulations, three rainfall events, 1 in 30, 1 in 100 and 1 in 1000 chance of occurring in any one year are modelled and mapped.

The uFMfSW was a national level broad-scale map indicating areas that are likely to be at risk from surface water flooding. The level of reliability varies from place to place and are assigned to 50m x 50m cells therefore it is not suitable for identifying individual properties at risk. .

3.2.5 Groundwater mapping

Areas Susceptible to Groundwater Flooding (AStGWF) is a strategic scale map showing groundwater flooding susceptibility on a 1km square grid. It was developed specifically by the Environment Agency for use by Lead Local Flood Authorities (LLFAs) for use in Preliminary Flood Risk Assessment (PFRA) as required under the Flood Risk Regulations. It is not available publicly.

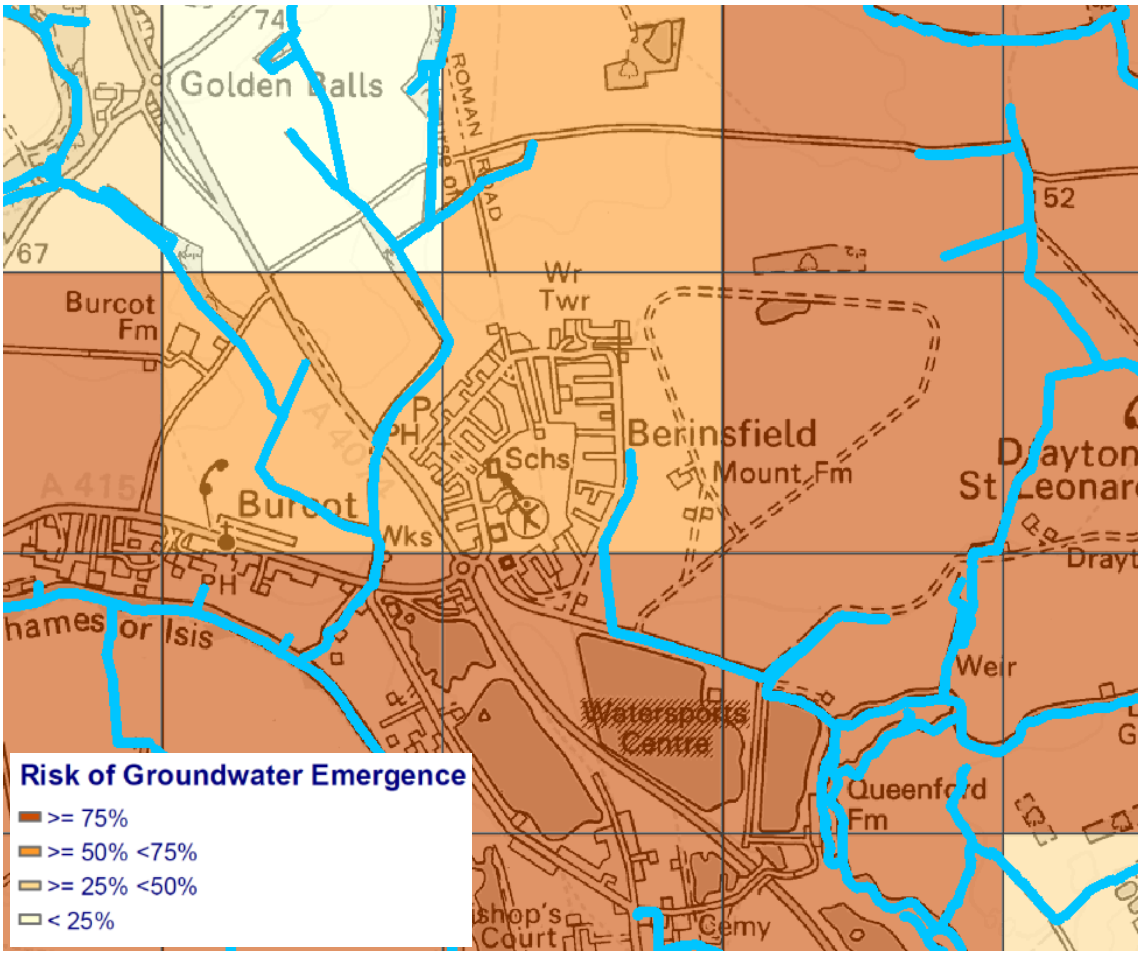
This data has used the top two susceptibility bands of the British Geological Society (BGS) 1:50,000 Groundwater Flood Susceptibility Map and thus covers consolidated aquifers and superficial deposits. The mapping shows the proportion of each 1km grid square where geological and hydrogeological conditions show that groundwater might emerge based on one of four area categories. It does not show the likelihood of groundwater flooding occurring or take account of the chance of flooding from groundwater rebound.

The data should not be interpreted as identifying areas where groundwater is actually likely to flow or pond, thus causing flooding, and may be of use in identifying where further studies may be useful.

Figure 3-2 below shows the proportion of each 1km square that is susceptible to groundwater flood emergence for Berinsfield. The AStGWF map suggests that the majority of Berinsfield is at medium risk of groundwater emergence, increasing to the highest risk category to the south where it is closer to the River Thames alluvial gravels.

The SODC and VOWH SFRA reported that for Berinsfield there were no incidents mapped in the Defra report for 2000/1 and 2002/3 events and no incidents were recorded by Environment Agency at the time.

Figure 3-2: Areas Susceptible to Groundwater Flooding taken from updated SFRA



3.2.6 Sewer flood risk mapping

The sewer flooding register provided by Thames Water is a register held by water companies on the location of properties at risk of foul and/or surface water sewer related flooding problems showing the number of properties flooded by 'overloaded sewers' within the Districts over the past ten years by postcode area. 'Overloaded sewers' is the Ofwat definition of flooding due to excessive flows in sewers. Thames Water do not make publicly available figures for other causes of flooding including blockages, collapses and equipment failure, because such problems should be rectified in a relatively short time and unlikely to recur.

The incidents recorded relate to incidents of flooding due to a wide range of storm return periods, and may include repeated incidents at a single property. Where improvements have been made by Thames Water to rectify a known flooding problem, the affected properties are taken off the register.

Given that only ten years of incidents are provided, it is reasonable to assume that there are more properties at risk of sewer flooding which haven't experienced the rainfall or other conditions to cause flooding during this period. Comparison of the sewer flooding register data with locally reported sewer flooding issues suggests that it does not always provide a true representation of risk. In the case of sewer flooding, more reliance should be placed on locally gathered knowledge and information on sewer flooding incidents when assessing flood risk for development. The analysis of surface water flooding can also help to indicate likely locations at risk of sewer flooding, since in extreme floods the importance of above ground flow routes is arguably as or more significant than underground piped drainage systems.

The OX10 7 postcode has 8 properties on the Thames Water register, including 3 at risk of internal flooding, but it is not known where these properties are. No other evidence of sewer flooding was received.

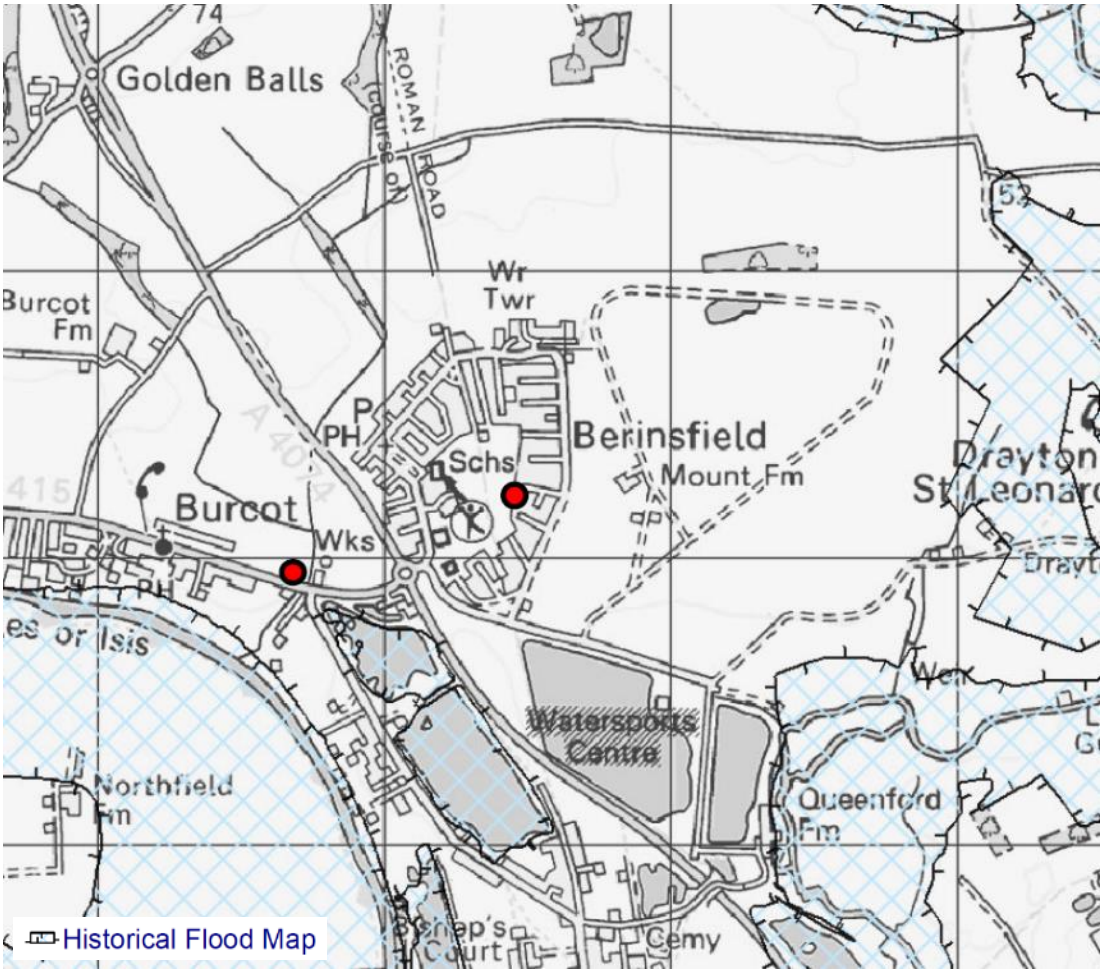
3.2.7 Historic Flood Map

The Environment Agency maintains and updates a **Historic Flood Map (HFM)**, which shows the combined extents of known flooding from rivers, the sea, and groundwater. Events are only included where there sufficient information to accurately map them. **No information** about the date of the event, or the mechanism of flooding **is recorded in the layer.**

It is worth noting that HFM outlines are used to define Flood Zone 2, where they are more extensive than the modelled Flood Zone 2 outline and where there is an appropriate level of confidence in the source and extents of the historic event.

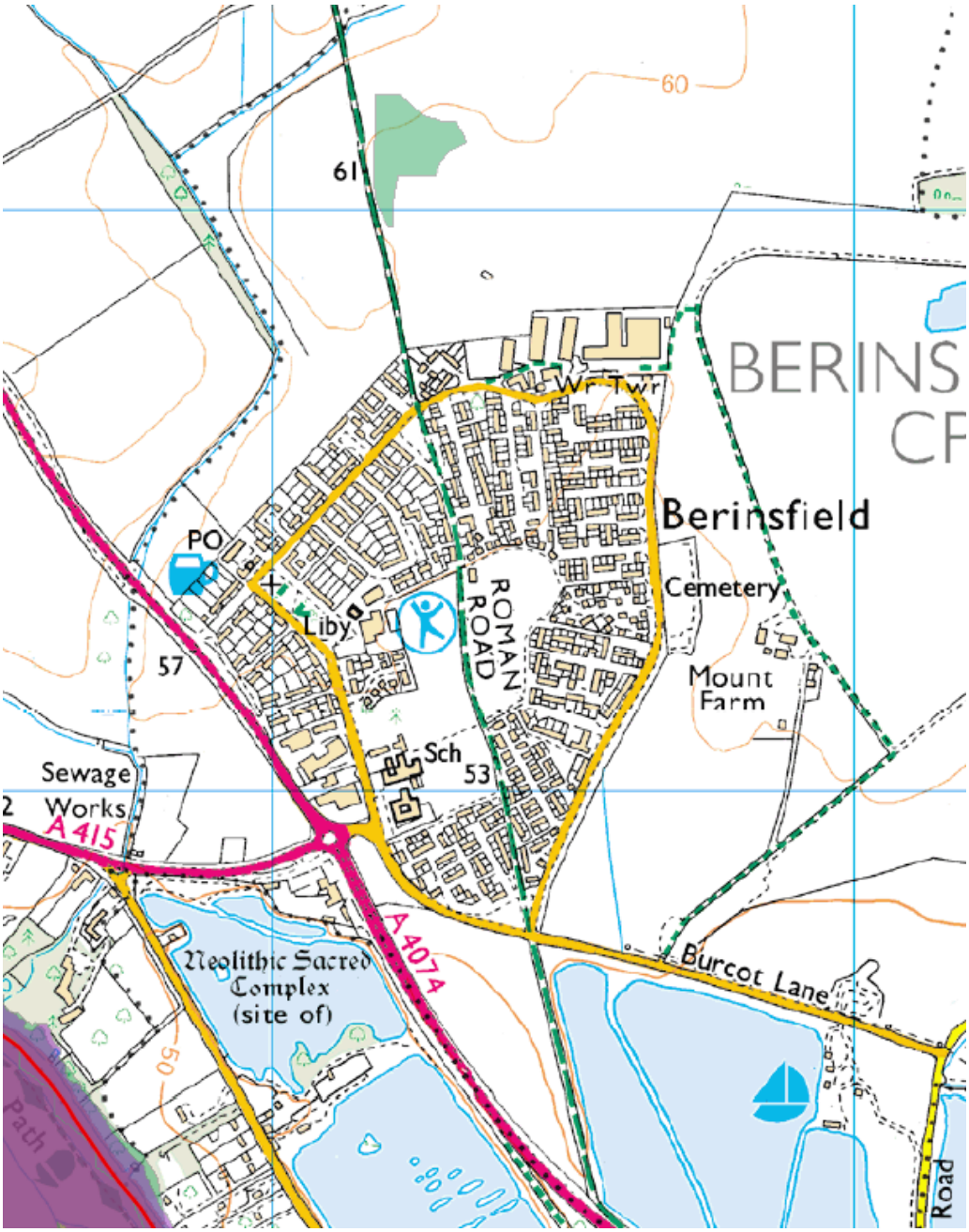
Figure 3-3 shows that there is no historical flooding within Berinsfield. The red dot on the map represents between one and five incidents were made to the District Council, normally to request sandbags, within Berinsfield. This data is from the SODC and VOWH SFRA, and the record of incidents is from 2013.

Figure 3-3: Historical Flood Map taken from updated SFRA



Historic flood events outlines received from the Environment Agency show there to be no fluvial flooding within Berinsfield for the 1947, 1977, 1979, 2002, 2007 and 2008 flood events. A small area north of Berinsfield was shown to be flooded in the 2002 event, however none of the proposed development sites overlap this area. See Figure 3-4 below.

Figure 3-4: Flood Event Outlines



Contains Environment Agency information © Environment Agency and database right

Green - 2002 Flood Event Outline

3.2.8 Risk of flooding from reservoirs

The risk of inundation as a result of reservoir breach or failure can be viewed on the Environment Agency website under Risk of Flooding from Reservoirs[18], and is shown in Figure 3-5**Error! Reference source not found.**. The map shows the area that could be flooded if a reservoir holding 25,000 cubic metres of water or more were to fail and release all of its water. This is a worst case scenario and is unlikely to occur. Berinsfield is not at risk from flooding from reservoirs.

[18] Environment Agency, Risk of flooding from Reservoirs map http://maps.environment-agency.gov.uk/wiyby/wiybyController?x=357683.0&y=355134.0&scale=1&layerGroups=default&ep=map&textonly=off&lang=_e&topic=reservoir

Figure 3-5: Risk of flooding from reservoirs (from the Environment Agency website)

The blue region shows the maximum extent of the flooding.

3.3 Other flood risk evidence

3.3.1 Hydraulic modelling

The Flood Zones are based on broad scale modelling that has been refined with detailed hydraulic models and hydrological assessments in areas of higher risk.

The Environment Agency River Thames (Sandford to Whitchurch), 2000, hydraulic model forms the parts of the flood map from sailing club lakes towards the River Thames inclusive.

Most of the Flood Zone outlines covering Berinsfield are a result of the older, coarser historic JFLOW modelling which is known to be less accurate due to the data available at the time when this was undertaken. These outlines include the River Thame, Elaine's Ditch and Burcot Brook. Outlines from the broad scale mapping can be identified in the flood maps by the coarser/blockier appearance.

3.3.2 Flood history

The SFRA undertook a comprehensive assessment of historic flooding within key settlements. The historical flooding information that was assessed included:

- Requests for sandbags / flood records (SODC)
- Flood investigations carried out (SODC)
- Chronology of British Hydrological Events
- Internet search

No historical flooding records were found for Berinsfield within these sources except for a record of requests for sandbags.

Requests for sandbags / flood records

SODC records all requests for sandbags. Five requests were made to SODC between 2000 and 2013. One in 2000, two in both 2003 and 2007.

Full addresses or postcodes were not disclosed for the majority of the records, so it is not possible to locate the areas where they were requested. It should be noted that this data should be considered indicative of a flooding problem, for the following reasons:

1. Only includes incidents where the District Council were notified, normally to request sandbags. Very short flash floods will, in some cases, result in property flooding before contact can be made to the local authority. Or in other cases, residents or businesses make their own arrangements for protecting properties.
2. No reason for flooding is recorded.
3. Incidents only indicate when flooding was thought likely to occur – in some cases water levels may not have actually got high enough to cause flooding to properties.

4 Review of flood risk to identified site

4.1 Introduction

The Berinsfield NDP aims to locate development sequentially in areas of lowest flood risk. This section gives a summary of the flood risk associated with each of the 25 suggested development sites with a more detailed overview of each of the sites within Appendix A. The summary sheets should provide enough information to carry out the Sequential Test as outlined in the NPPF Technical Guidance.

4.2 Summary of development sites

Table 4-1 below summarises the flood risk to each site as identified within the summary sheets.

Table 4-1: Flood risk to Berinsfield potential development sites

Site reference	Fluvial		Surface water	Groundwater	Sewer
	Flood Zone 3	Flood Zone 2			
Ber1	Y	Y	Low	Medium / High	Low
Ber2	N	N	Low	High	Low
Ber3	Y	Y	Low	High	Low
Ber4	Y	Y	High	Medium / High	Low
Ber5	N	N	Low	Medium	Low
Ber6	Y	Y	Very Low	Medium	Low
Ber7	N	N	Very Low	Medium	Low
Ber8	N	N	Very Low	Medium	Low
Ber9	N	N	Low	Medium	Low
Ber10	N	N	Medium	Medium	Low
Ber11	N	N	Very Low	Medium	Low
Ber12	N	N	Very Low	Medium	Low
Ber13	N	N	Very Low	Medium	Low
Ber14	N	N	Very Low	Medium	Low
Ber15	N	N	Very Low	Medium	Low
Ber16	N	N	Low	Medium	Low
Ber17	N	N	Medium	Medium / High	Low
Ber18	N	N	Low	Medium	Low
Ber19	N	N	Very Low	Medium / High	Low
Ber20	N	N	High	Medium / High	Low
Ber21	N	N	Medium	High	Low
Ber22	N	Y - small intersection	Very Low	Medium / High	Low
Ber23	Y - small intersection	Y- small intersection	Low	Medium	Low
Ber24	Y	Y	Low	High	Low
Ber25	Y	Y	Low	High	Low

4.3 Site summary sheets

Flood risk from all sources has been described in more detail and mapped for each site. This information is provided in a 'summary sheet' format in Appendix A. Each summary sheet also gives further information about the implications for development. The following information is provided for each site:

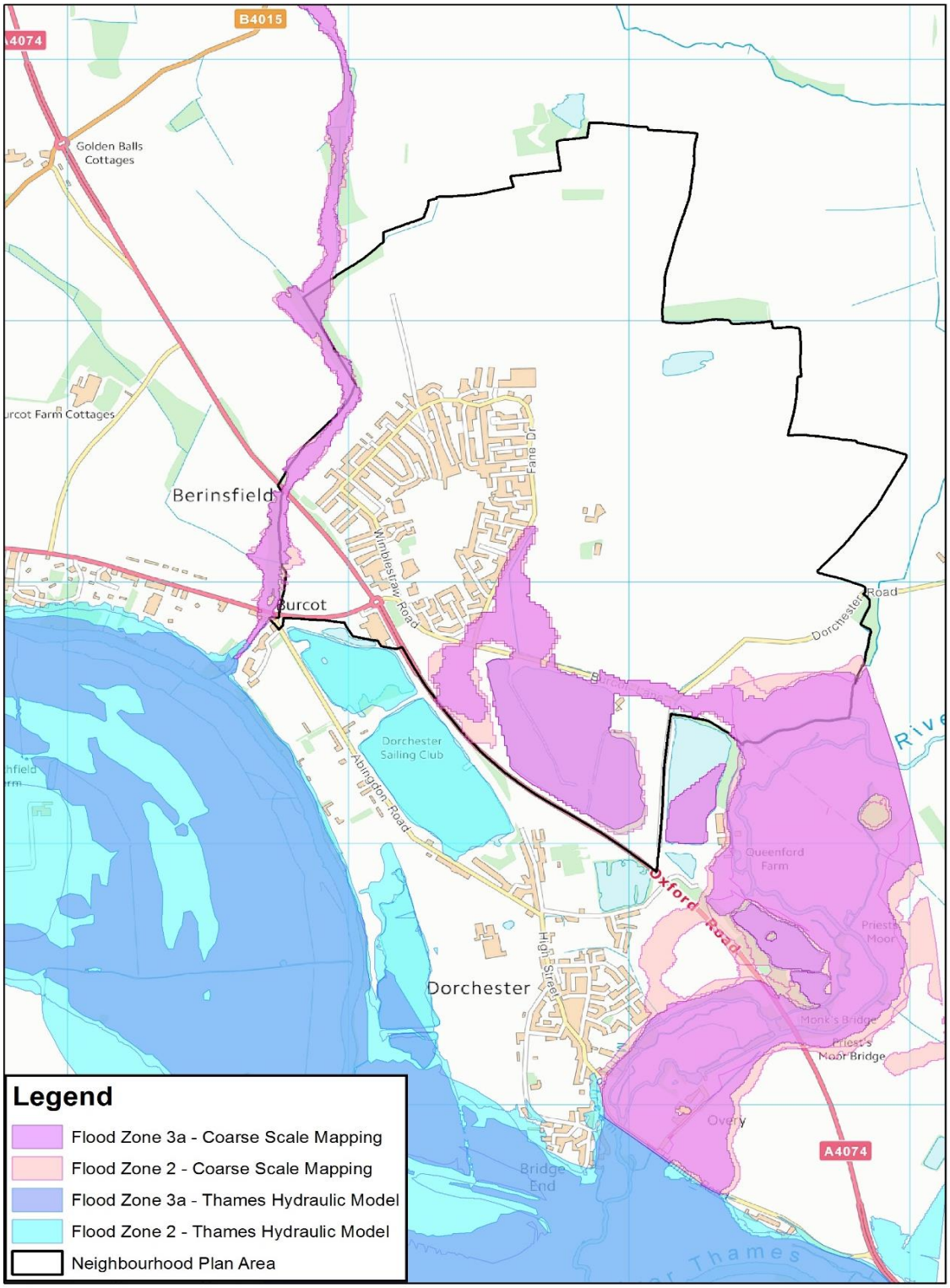
- Fluvial flood risk summary, Flood Zone map, source of Flood Zone information, flood defences.
- Surface water flood risk summary and updated Flood Map for Surface Water map
- Groundwater flood risk summary
- Sewer flood risk summary
- Effects of climate change
- Available survey and detailed modelling
- Implications for development

4.4 Sources of flood risk information within EA Flood Map

The EA national Flood Map is made up of a mosaic of flood outlines from numerous sources derived from a variety of modelling techniques. National broad scale modelling of the whole country was completed in 1999 to provide country wide flood zones, these outlines were refined to include areas where more detailed hydraulic models and hydrological assessments existed and have been updated over the last 15 years to include outlines derived from the numerous detailed modelling studies commissioned during this period.

Figure 4-1 below shows the Flood Map for Berinsfield highlighting the areas of the outlines derived from the national broad scale mapping and those from more detailed hydraulic studies.

Figure 4-1: EA Flood Map showing detailed hydraulic model outlines and national scale coarse modelling outlines



Because the accuracy of the different modelling techniques vary it is important to note the source of the information used in the specific area.

The flood map of Berinsfield is composed of flooding from three different sources, the River Thames, the River Thame and Elaine's Ditch and Burcot Brook. A detailed assessment of the individual watercourses, the type of hydraulic model used to produce the flood outlines for these and accuracy of the technique are included below.

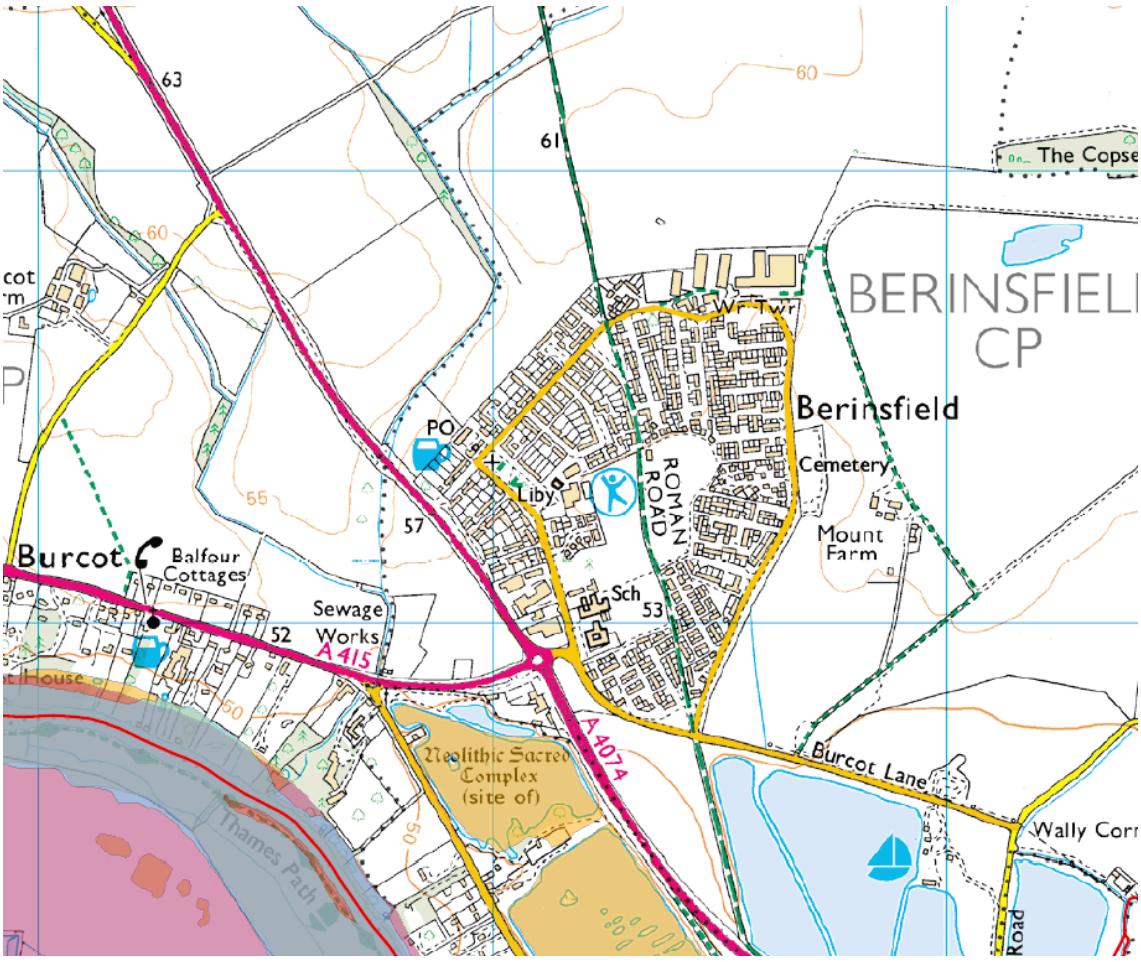
River Thames

The River Thames is a large river and presents a flood risk to many properties, and as a result was one of the first rivers in the UK to have a computational hydraulic model developed back in the mid 1980's. The most recent flood outlines from the Thames which are used in the EA Flood Map (shown in Figure 4-3), originate from the River Thames (Whitchurch - Henley model) Flood Mapping Study completed in August 2000 and subsequently updated with additional climate change data in February 2006.

The study was carried out using 1D modelling software which calculates a water level at each cross section (or node) along the watercourse length. These levels are then extrapolated across the floodplain using LIDAR (topographical mapping) with areas below the modelled water level shown as flooded. The outlines are checked to ensure no area beyond a natural embankment which would prevent water extending beyond it are shown as flooded. The EA state the model accuracy of the water levels at each node to ±250mm.

The Dorchester Sailing Club Lake was not shown to be flooded by the hydraulic model but is included within the Flood Zone 2 outline since it was within the 1977 historical Flood Event Outline.

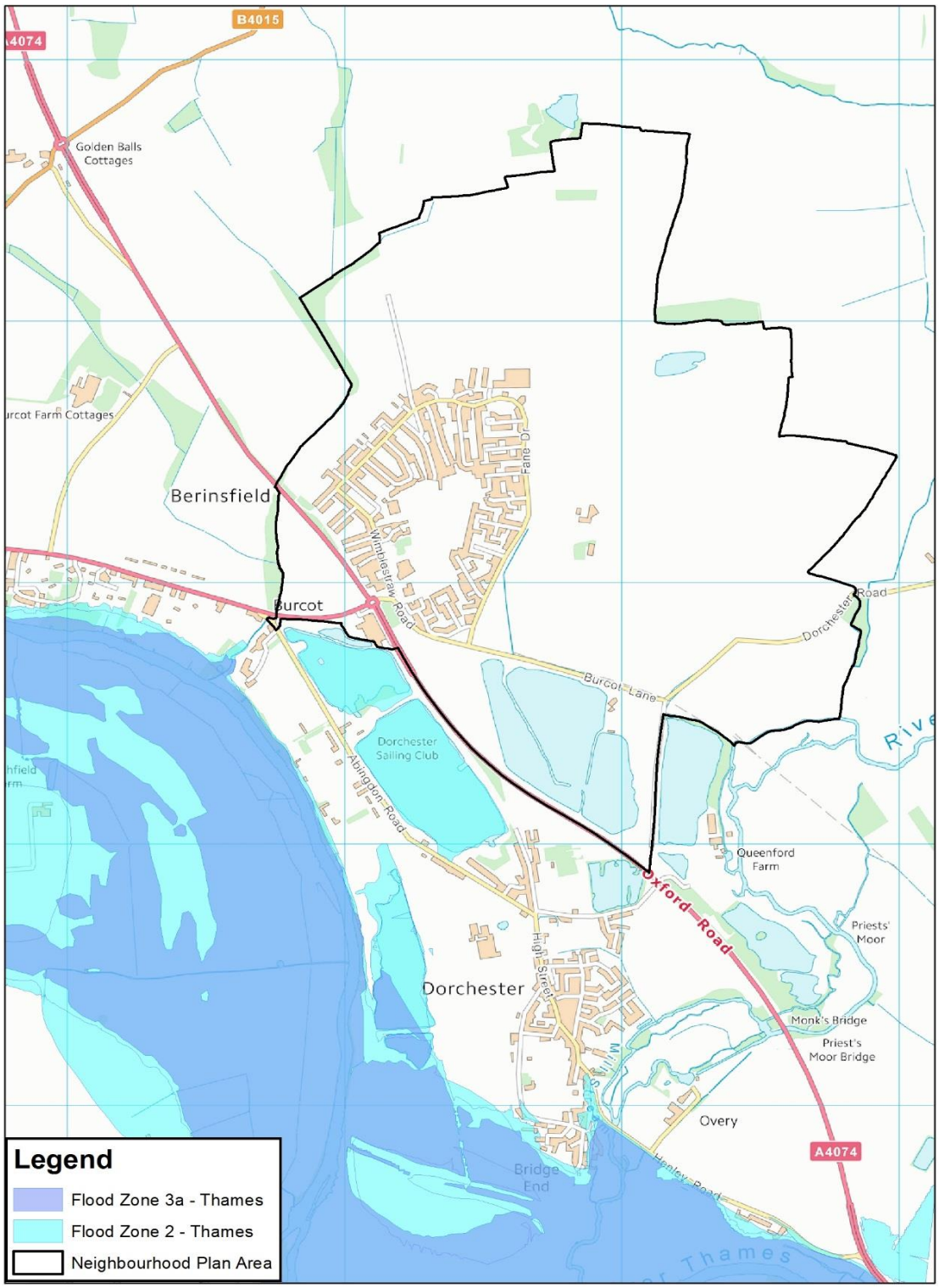
Figure 4-2: Flood Event Outline - 1977



Contains Environment Agency information © Environment Agency and database right

Orange - 1977 Flood Event Outline

Figure 4-3: Section of the EA Flood Map caused by flooding from the River Thames



Burcot Brook, River Thame and Elaine's Ditch

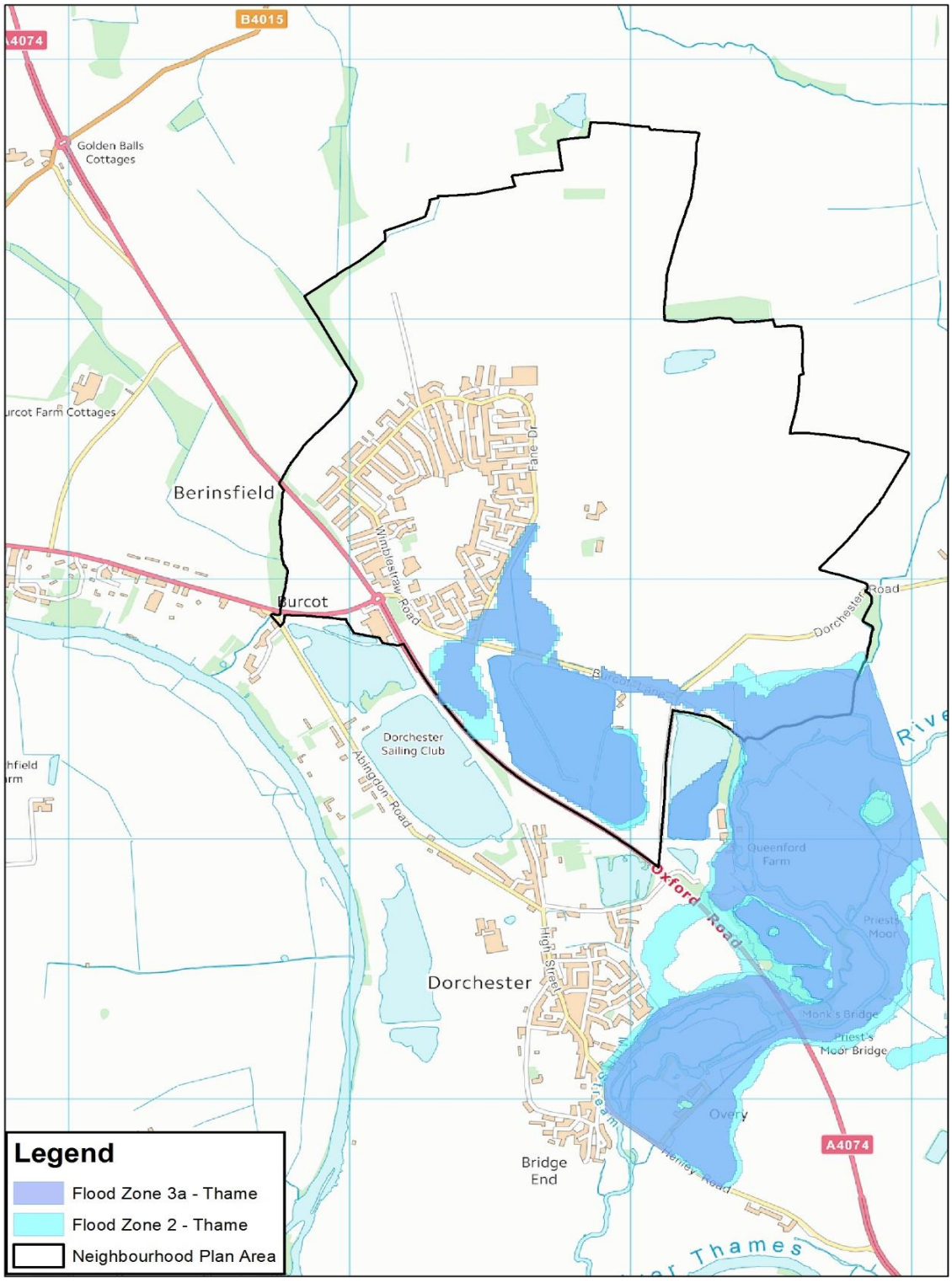
Flooding from the River Thame and Elaine's Ditch cannot be separated and therefore they have been included together within Figure 4-4, the flood outline generated as a result of flooding from the Burcot Brook is shown in Figure 4-5.

A detailed hydraulic modelling study was undertaken on the River Thame further upstream (through Thame itself) however as the lower reaches of the river are rural with only a few villages there has been no requirement for the EA to produce a detailed hydraulic model.

The Flood Map outlines for the River Thame, Elaine's Ditch and Burcot Brook are represented by the coarser scale (and less accurate) national JFLOW modelling. Large scale flooding in the late 1990's resulted in the need for a flood map with national coverage and as a result of this the national scale JFLOW mapping was commissioned with the first maps completed in 1999.

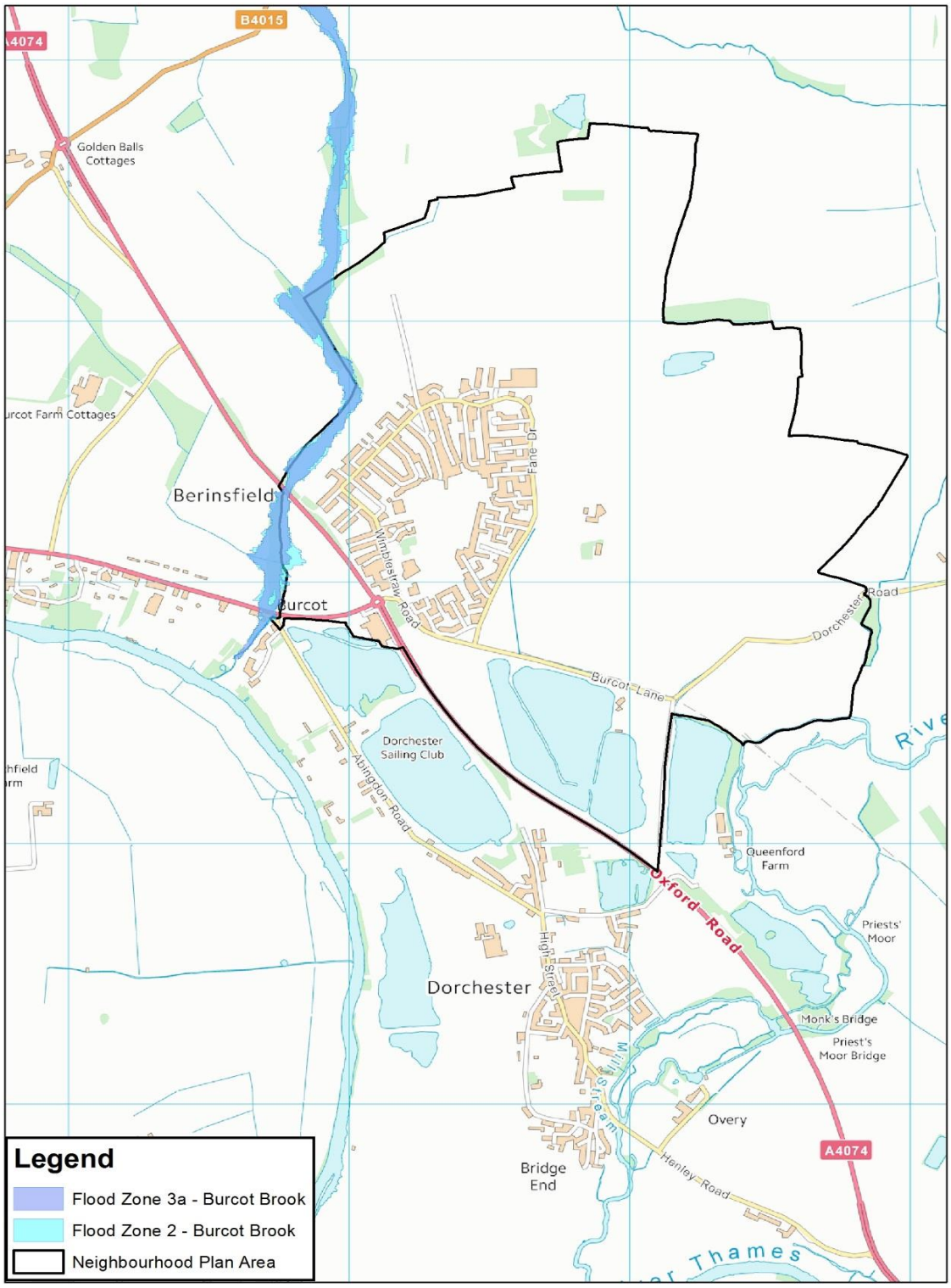
The flood outlines from JFLOW modelling were constructed by allowing water from many flow calculation points along a watercourse to flow freely in any direction across a model of the ground surface, each of these separate outlines were then overlaid on top of each other to create a single map.

Figure 4-4: Section of the EA Flood Map caused by flooding from the River Thame and/or Elaine's Ditch



As well as the river flows being calculated on a national scale the greatest inaccuracy associated with this type of modelling was the large scale DEM (Digital Elevation Model) ground model used, often 5m grid cell size (with a vertical accuracy of between 0.7-1m) compared with 2m or 1m (0.15m vertical accuracy) typically used in current detailed hydraulic models. The large grid cell size also explains why the outlines from these maps look blockier compared to the smooth detailed models or historic flood outlines.

Figure 4-5: Section of the EA Flood Map caused by flooding from the Burcot Brook



Due to the inaccuracies with the hydrology and the coarse and now old DEM used within the JFLOW modelling the outlines from the River Thame, Elaine's Ditch and Burcot Brook will be less accurate than those from the River Thames.

5 Guidance

5.1 Introduction

Planners and developers should follow the Environment Agency Flood Risk Standing Advice[19] as a starting point when considering applications for new development. This section will summarise guidance for developers planning development within Flood Zones 1, 2, 3a and 3b in and around Berinsfield and provide guidance for what should be included within site specific Flood Risk Assessments. This section should be read in conjunction with the flood risk summary sheets which show the location of the site with respect to the Flood Zones.

Table 3 of the NPPF Technical Guide highlights the type of development considered appropriate for each Flood Zone, where development is not permitted, and where development is allowed only when the Exception Test is passed. Further detail is provided in the NPPF Technical Guidance.

5.2 Permitted development in Flood Zones

5.2.1 Flood Zone 1

All development (essential infrastructure, highly vulnerable, more vulnerable, less vulnerable and water-compatible development) is allowed in Flood Zone 1. All development proposals should consider the following about the sites:

- Their vulnerability to flooding from other sources as well as from fluvial flooding.
- Their potential to increase flood risk elsewhere through the addition of hard surfaces and the effect of the new development on surface water runoff.

5.2.2 Developments >1ha in Flood Zone 1

A detailed FRA must be undertaken by a suitably qualified professional. It should:

- Assess risk from other sources of flooding which are not considered within the Flood Zone maps.
- Recommend mitigation measures in response to any identified flood risk.
- Assess the impact of a proposed development upon surface water drainage following an increase in impermeable area, including the potential impact upon areas and receiving watercourses downstream, and recommend the approach to control surface water discharge.
- Demonstrate the ability to meet the following drainage requirements to avoid increasing flood risk elsewhere:
- Greenfield discharge rates
- Attenuation up to the 1% annual probability event plus climate change
- Consider the use of SuDS

Opportunities for developing an Integrated Water Management Strategy across development site boundaries should be explored, and a catchment led approach should be adopted. An integrated approach to controlling surface water drainage can lead to a more efficient and reliable surface water management system as it enables a wider variety of potential flood mitigation options to be used. In addition to controlling flood risk, integrated management of surface water has potential benefits, including improved water quality and a reduction of water demand through rain-water recycling and reuse.

Integrated drainage systems may be considered suitable for catchments where other development is being planned or constructed, and where on-site measures are set in isolation of the systems and processes downstream.

19 Environment Agency Flood Risk Standing Advice http://www.environment-agency.gov.uk/research/planning/82584.aspx

Further information on the details to be provided within the FRA can be found in the Environment Agency's FRA Guidance Note 1[20] and the CIRIA report C624[21].

5.2.3 Developments <1ha

If a site within Flood Zone 1 site has been identified by this FRA as having a known drainage problem, or has experienced flooding from other sources, then a detailed FRA is required as outlined in Environment Agency's FRA Guidance Note 1[20].

For those proposed developments where there is not a known drainage issue then a detailed FRA is not required. Nevertheless, the proposed development should include the appropriate application of sustainable drainage techniques so as to maintain, or preferably reduce the existing runoff and flood risk in the area.

5.2.4 Flood Zone 2

Flood Zone 2 is considered suitable for water-compatible, less vulnerable, more vulnerable and essential infrastructure, following application of the Sequential Test. Highly vulnerable development is only allowed where the Exception Test is passed. Depending on the type of development proposed, a Flood Risk Assessment may be required, see Table 3 Flood risk vulnerability and flood zone 'compatibility' within the NPPF Technical Guide. Planners and developers are to be aware that a FRA should be appropriate to the scale and size of the development and undertaken by a suitably qualified professional. The following should be included within a FRA for developments within Flood Zone 2:

- Consideration of all sources of flooding (e.g. surface water, sewer, and groundwater), not just fluvial flood risk, for the lifetime of the development.
- Demonstration of the ability to avoid increasing flood risk elsewhere through the addition of hard surfaces, to control the potential impact new development may have on the surface water run-off regime. To control the effect of new development on potential depth and speed of flooding to adjacent and surrounding property and to meet the following drainage requirements:
- Greenfield discharge rates
- Attenuation up to the 1% annual probability event plus climate change
- Use of SuDS
- An assessment of the effect of climate change on flood risk.
- Recommendations of mitigation measures in response any identified flood risk.
- Demonstration that residual risks of flooding (after existing and proposed flood management and mitigation measures are taken into account. This includes flood defences, flood resilient and resistant design, escape/evacuation, effective flood warning and emergency planning) are acceptable

Any proposed development will be required to provide evidence that the Sequential Test, and if required the Exception Test, have been passed. A preliminary FRA, using data from the Neighbourhood Plan FRA and any necessary further modelling work (where detailed modelling within the Neighbourhood Plan FRA is not decisive enough), will be required to ascertain the level of flood risk for Sequential Test purposes. It is strongly recommended that the Sequential Test, and, if necessary, the Exception Test be satisfied before the FRA detailing design and mitigation measures is commenced.

Further information on the details to be provided within the FRA can be found in the Environment Agency's FRA Guidance Note 3[22] and CIRIA report C624.

5.2.5 Flood Zone 3a

Water-compatible uses and less vulnerable development are allowed in this Flood Zone, following application of the Sequential Test. Highly vulnerable development is not permitted, and essential infrastructure and more vulnerable development need to pass the Exception Test. Essential

20 Environment Agency, FRA Guidance Note 1
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/311502/LIT_9193.pdf
21 CIRIA (2004) Development and Flood Risk: Guidance for the Construction Industry. Report C624
http://www.ciria.org/ItemDetail?iProductCode=C624&Category=BOOK
22 Environment Agency, FRA Guidance Note 3
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/311509/LIT_9186.pdf

infrastructure should be designed and constructed to remain operational and safe for users in times of flood.

Where, due to wider sustainable development reasons, there are no other suitable sites available in lower risk zones then an assessment of the residual risk within Flood Zone 3 is required. For developments to proceed it must also be shown that the development will not increase flood risk elsewhere through a loss of storage or conveyance. Flood risk must be reduced or kept at current levels.

A detailed FRA must be undertaken by a suitably qualified professional. It is required to provide evidence that the Sequential Test, and if required the Exception Test, have been passed. A preliminary FRA, using data from the Neighbourhood Plan FRA and any necessary further modelling work (where detailed modelling within the Neighbourhood Plan FRA is not decisive enough), will be required to ascertain the level of flood risk for Sequential Test purposes.

It is strongly recommended that the Sequential Test, and, if necessary, the Exception Test be satisfied before the FRA detailing design and mitigation measures is commenced. The Sequential Test will already have been applied to adopted site allocations. In the case of windfall sites, developers should speak to the local planning authority to confirm whether developer or planning authority will undertake the sequential test. However, there will be a presumption against development within Flood Zone 3a and 3b.

The FRA should:

- Consider all sources of flooding (e.g. surface water, sewer, and groundwater), not just fluvial flood risk.
- Demonstrate the ability to meet the following drainage requirements to avoid increasing flood risk elsewhere:
- Greenfield discharge rates
- Attenuation up to the 1% annual probability event plus climate change
- Use of SuDS
- Assess the effect of climate change on flood risk.
- Consider the residual risks behind defences, if present.
- Any new “More Vulnerable” or “Highly Vulnerable” development, particularly involving the creation of new residential units, will require dry access and egress up to the 1 in 100 year flood event, with an allowance for climate change over the lifetime of the development.
- Ensure that flood risk is reduced overall, for example that:
- Flood flow routes are preserved
- Floodplain storage capacity is not reduced, and where necessary is compensated for on a level for level basis outside of the floodplain.
- The site is designed sequentially. Relocate existing development to land in zones with a lower probability of flooding. Ensure mitigation measures are provided in response to flood risk and
- Safe access and egress from the proposed development to safe ground can be assured.

Further information on the details to be provided within the FRA can be found in the Environment Agency’s FRA Guidance Note 3[23] and the NPPF Technical Guidance.

5.2.6 Flood Zone 3b – the Functional Floodplain

The functional flood plain is defined as “land where water has to flow or be stored in times of flood.” Only water-compatible uses are allowed in this Flood Zone. Essential infrastructure can be permitted after the Exceptions Test is passed. Essential infrastructure built within the functional floodplain should:

- Remain operational and safe for users in times of flood;
- Result in no net loss of floodplain storage;
- Not impede water flows; and

[23] Environment Agency, FRA Guidance Note 3
https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/311509/LIT_9186.pdf

- Not increase flood risk elsewhere.

The NPPF Technical Guidance recommends that Local Planning Authorities define the functional flood plain in discussion with the Environment Agency. This was done during the preparation of the SFRA.

Flood Zone 3b should be considered as the 1 in 20 year flood extents where these have been modelled and mapped, (Thames Sandford to Whitchurch 2000). Where there is not detailed modelling, a precautionary approach should be followed and Flood Zone 3 should be considered as equivalent to the functional floodplain (Elaine's Ditch and Burcot Brook).

The Parish Council should be seeking risk reduction on any sites within Flood Zone 3b. When such land comes up for redevelopment, planning applications should strive for:

- Removal of buildings and restoration of the functional floodplain, including linkage between the watercourse and floodplain.
- Changing the land use to a less vulnerable classification.
- Changing the layout and form of the development (e.g. reducing the building footprint).
- Preserving flow routes.
- Improving conveyance/storage, e.g. replacing solid building with floodable structures.
- Sequential approach to design of site (see Section 5.2.7)

5.2.7 Sites within more than one Flood Zone

Flood risk should be considered at an early stage in deciding the layout and design of a site to provide an opportunity to reduce flood risk within the development. In particular large development proposals may include a variety of land uses of varying vulnerability to flooding.

Where a site covers more than one Flood Zone, the sequential approach should be applied within development sites to design the site layout to reduce flood risk as much as possible.

A sequential, risk-based approach should be applied to try to locate more vulnerable land use to higher ground, while more flood-compatible development (e.g. recreational space) can be located in more high risk areas subject to appropriate management.

Low-lying waterside areas, or areas along known surface water flow routes, can be used for recreation, amenity and environmental purposes, allowing the preservation of flow routes and flood storage, and at the same time providing valuable social and environmental benefits contributing to other sustainability objectives.

Landscaping should ensure safe access to higher ground from these areas, and avoid the creation of isolated islands as water levels rise.

5.2.8 Recommendations for existing settlements within Flood Zones 2 and 3

The Parish Council should aim to reduce the risk from flooding at every opportunity. If existing developments within Flood Zones 2 and 3 apply for planning permission it would be recommended that they follow the below recommendations after following a Sequential Test.

Reducing vulnerability: On change of use of sites, opportunities should be taken to reduce vulnerability to flooding, by promoting less vulnerable and water compatible land uses.

Layout and footprint: On redevelopment of a site, opportunities should be taken to reduce the building footprint, thus improving floodplain storage and flow paths.

Residential Infill: Residential infill (for example construction of a new property in the garden of an existing property) will be required to pass the Sequential Test within established residential areas in Flood Zones 2 and 3.

Extensions: Extensions to existing properties should not be permitted in Flood Zone 3a, unless their design is flood resilient.

Residential development above shops: Residential developments above shops in Flood Zone 3 should demonstrate that dry access and egress will be maintained. Where this is not feasible, safe access should be ensured.

5.3 Flooding from other sources

Planners and developers should use the flood risk summary sheets presented in this FRA along with other available evidence to identify where there is a risk of flooding from other sources, including sites within Flood Zone 1. Recommended criteria for identifying significant evidence of flooding from other sources have been taken from the SFRA.

Source of Flooding	Criteria for evidence of "significant risk"	Impact for Berinsfield sites
Historic flooding	Any reliable evidence of historic flooding at or adjacent to the site.	No areas identified as a location of historic flooding.
Minor watercourses	Proximity to the watercourse	Sites within Elaine's Ditch and Burcot Brook at greatest risk.
Surface water	Predicted surface water depths greater than 0.3m at or adjacent to the site.	
Groundwater	Risk in highest category on AStGWF map, supported by evidence of groundwater events in the local area.	Sites closest to Thames and in south of village at greatest risk.
Sewer	Sewer flooding to existing properties on or near the site. Sewer flooding records provided by Thames Water are not detailed enough to identify site-specific risks. However, Thames Water will comment on larger planning applications, and on Local Plans.	Overall at low risk, although site specific risks unknown.
Flooding from reservoirs, canals and other artificial sources	Within flood envelope on Environment Agency reservoir maps	None

In considering allocations or applications for development on sites with a risk of other sources of flooding, planners should:

- Provide a detailed assessment of the risk from that source, for example using hydraulic modelling, surface water modelling or groundwater investigations as appropriate.
- Sequentially design the site to locate the built element of the development away from the source of flood risk.
- Ensure that the development will not make flooding any worse, and if possible reduce the level of flood risk, e.g. by preserving surface water flow routes.
- Consider the effect of climate change on flooding from other sources.
- Ensure that suitable mitigation measures against flooding from other sources are included in the development.
- Substitute less vulnerable development types for those incompatible with the degree of flood risk.

5.4 Surface water runoff and drainage

A FRA should consider how surface water will be managed on the development site. A preliminary drainage strategy should be fully outlined in the FRA, even at a speculative stage. Any locations where surface water or sewer flooding are an issue should consider the impact of climate change on rainfall intensity as outlined in the NPPF Technical Guidance.

Site drainage should be to SuDS infiltration systems where practicable. This may not be practical within Berinsfield, especially sites closest to the Thames, where the water table is close to the surface. As an alternative green roofs and swales should be considered to reduce runoff rates. Within the FRA appropriate assessments should be carried out for green and brownfield developments.

Redevelopment of brownfield sites offers the opportunity to remove connectivity to foul or combined sewerage systems, with consequent benefits for reducing sewer flooding and the potential of pollution from combined sewer overflows (CSOs).

5.4.1 Runoff rates

The design philosophy for greenfield sites requires that site drainage be limited to the greenfield runoff rate, up to the 1 in 100 year design event. Guidance on calculating greenfield runoff rates is given in the Defra/EA guide to preliminary rainfall runoff management for developments[24].

The Environment Agency will expect, where practicable, that the developer should design drainage of a brownfield site such that there is a reduction in flows from the previous usage.

5.4.2 Sustainable Drainage Systems (SuDS)

Sustainable Drainage Systems (SuDS) are management practices which enable surface water to be drained in a more sustainable manner.

There are many different SuDS techniques which can be implemented. The effectiveness of a flow management scheme within a single site is heavily limited by site constraints including (but not limited to) topography, geology (soil permeability), and available area. The design, construction and ongoing maintenance regime of such a scheme must be carefully defined, and a clear and comprehensive understanding of the catchment hydrological processes (i.e. nature and capacity of the existing drainage system) is essential. Infiltration SuDS require the water table to be low enough, which may not be practical within Berinsfield, particularly sits closest to the Thames. A site specific infiltration test will show whether infiltration SuDS could be an option or not.

FRAs should consider the long-term maintenance and ownership of SuDS.

Oxfordshire County Council will become a SuDS Approval Body (SAB) by the enactment of Schedule 3 of the Flood and Water Management Act 2010, which is likely to be from April 2015. This means that all new development which has surface water drainage implications will potentially require SAB approval and need to conform to National and Local Standards. In the interim Oxfordshire County Council has taken a pro-active stance to its role and, relative to many other Lead Local Flood Authorities, has been actively involved in assessing the suitability of SuDS schemes for new development, working with colleagues in Highways, Development Control, City and District Councils and developers.

Further guidance on SuDS can be found at the documents and websites below:

- Susdrain website[25] - online community for delivering sustainable drainage
- CIRIA documents - there are several CIRIA guides relating to SuDS, most notably The SuDS Manual[26] and the more recent publication Retrofitting for surface water management[27]. The Susdrain website is a good guide to the available documentation.
- Environment Agency SuDS guidance[28] - Environment Agency advice for developers
- Interim Code of Practice for Sustainable Drainage Systems[29]

Connection of surface water drainage to an existing surface water sewer should only be considered as a last resort. Thames Water should be consulted at an early stage to ensure that sufficient capacity is available in the existing drainage system.

5.5 Wastewater

Major developments must carry out wastewater capacity checks and should liaise with Thames Water at an early stage to prevent an increase in sewer flooding and/or spills from combined sewer overflows (CSOs) further down the wastewater system as a result of the development.

The impact of an increased volume of foul water discharge on watercourses should also be considered for large sites, or where several sites are likely to be developed in the same Sewage Treatment Works (STW) catchment, particularly where the receiving STW discharges into the same watercourse as the surface water runoff from the site.

[24] Defra/ Environment Agency (2005) Preliminary rainfall runoff management for developments. R&D Technical Report W5-074/A/TR/1. http://archive.defra.gov.uk/environment/flooding/documents/research/sc030219.pdf
[25] Susdrain website http://www.susdrain.org/
[26] CIRIA (2007) The SuDS Manual (C697)
[27] CIRIA (2012) Retrofitting for surface water management (C713)
[28] Environment Agency SuDS guidance http://www.environment-agency.gov.uk/business/sectors/39909.aspx
[29] National SuDS Working Group (2004) Interim Code of Practice for Sustainable Drainage Systems. http://www.environment-agency.gov.uk/static/documents/Business/icop_final_0704_872183.pdf

5.6 Making development safe

5.6.1 Flood resistance and resilience

Resistance and resilience measures are measures which reduce the impact of flooding or increase the ability of people or buildings affected to recover from flooding. These measures are particularly relevant where minor developments (such as domestic extensions) are allowed in flood risk areas as opposed to larger developments. Possible measures include:

- Flood resistance measures are used to prevent water from entering a building, e.g. flood barriers across doorways and airbricks, raising flood levels, non-return valves.
- Flood resilience measures are used when water is designed to enter the building, but cause minimal damage and can be quickly returned to use after a flood, e.g. raising electrical sockets, tiled floors.

The measures chosen will depend on the nature of the flood risk, and obviously development vulnerable to sewer flooding will require a different approach to one at risk from fluvial flooding.

Further guidance is available in the Department of Communities and Local Government's document, improving the flood performance of new buildings[30].

5.6.2 Safe access and egress

For development in Flood Zone 3 it is necessary to provide safe access and egress during a flood.

'Safe' access should remain dry for 'more' and 'highly vulnerable' uses and should preferably be dry for other uses such as 'less vulnerable' land use classifications. Dry escape for residential dwellings should be up to the 1% annual probability event (100 year return period) taking into account climate change for fluvial flood risk.

The developer will be asked (if this is not already included in the FRA) to review the acceptability of the proposed access using the 'Flood Risk to People' FD 2320 calculator. In this instance it needs to be demonstrated that depths and velocities of flood water will be acceptable to the 'risks to some' category of this calculator.

5.7 Water quality and biodiversity

All development should assess the impact of site drainage on the WFD status of the waterbody the water will drain into. The assessment should consider both water quality and quantity as a change to one or both of these may have a detrimental impact on the waterbody which will need to be mitigated for. For example SuDS schemes can alter the discharge runoff rate into watercourses and consideration needs to be given to the impact of this change on the physical structure of the watercourse and its ecology.

5.8 River restoration and enhancement

All new development close to rivers and culverts should consider the opportunity presented to improve and enhance the river environment. As a minimum, the Councils and developers should aim to set back development 8m from the river, providing a buffer strip to 'make space for water' and allow additional capacity to accommodate climate change. The 8m buffer should not contain any built environment including roads, lighting and fencing.

Developments should look at opportunities for river restoration, de-culverting and river enhancement, such as restoration of meanders, as part of the development. Restoration can take place on various scales, from small enhancement measures to full river restoration.

These measures can have benefits such as reducing the costs of maintaining hard engineering structures, reducing flood risk, improving water quality and biodiversity. Social benefits are also gained by increasing green space and access to the river.

Advice on river restoration, de-culverting and providing other environmental enhancements on development sites is available from the Environment Agency[31]. Early consultation is recommended.

[30] Department of Communities and Local Government (2007) Improving the Flood Performance of New Buildings: Flood Resilient Construction http://www.planningportal.gov.uk/uploads/br/flood_performance.pdf

[31] Environment Agency (2006). Building a better environment. A guide for developers http://www.environment-agency.gov.uk/static/documents/1_GETH1106BLNE-e-e(1).pdf

Any modifications made as part of a proposed opening up and/ or restoration of river channels and corridors should be designed by suitable professionals and a full flood risk assessment of the impact of the modifications will be required to be carried out.

5.9 Existing watercourses, defences and assets

Permanent or temporary works within or adjacent to a watercourse require a Land Drainage Consent from the Environment Agency (in the case of Main rivers) or from the District Councils who act on behalf of the LLFA for ordinary watercourses.

Where developers are riparian owners, they should also assess existing assets (e.g. bridges, culverts, river walls, embankments) and renew them to last the lifetime of the development. Enhancement opportunities should be sought when renewing assets and should account for climate change.

Further culverting and building over culverts should be avoided. All new developments with culverts running through the site should seek to de-culvert rivers for flood risk management and conservation benefit. Wherever possible, existing watercourses and drainage channels should be retained, offering risk management authorities benefits in terms of maintenance, future upgrading, biodiversity and pollution prevention. The CIRIA (2010) Culvert Design and Operation Guide provides guidance in this area[32].

Where a culvert is present, the FRA must consider risk from the culvert being both 0% blocked and 75% blocked.

5.10 Developer contributions to flood risk improvements

Major development offers a unique opportunity to reduce the level of flood risk, both to the development area, and also to existing communities. Changes to legislation mean that it is now much easier for developers to contribute towards the cost of flood risk improvements.

Without allocated sites, location specific recommendations on developer contributions or strategic options cannot be made at this stage. The improvements tend to be small scale channel and culvert improvements works, generally funded at the moment by Flood and Coastal Risk Management (FCRM) Grant in Aid (GiA). Developers can be asked to make direct contributions to flood alleviation schemes affecting the communities close to the development.

5.11 Climate change adaption and mitigation

An important part of the FRA analysis process is the consideration of future climate change and the increased impact that development may have as a result of that climate change. When reviewing development plans it is important to understand not only the current predicted flood risk to a site but also the flood risk for the life time of the development. For residential development the analysis is undertaken based on a development lifetime of 100 years. The focus has been on new development however the key features apply equally to retro-fit of adaptation and mitigation measures to existing development.

5.11.1 Adaptation

The UK Climate Change Impacts Programme (UKCCIP) report Identification of Adaptation Options[33] presents a framework for identifying and appraising adaptation measures.

Adaptation options can be grouped into four categories, which are discussed below:

No-regrets options

No-regrets options are adaptive measures that deliver benefit whatever the extent of future climate change. Those relevant to the FRA include the following examples:

- Avoiding building in high-risk areas (e.g. flood plains) when locating development (Sequential Test)
- Reducing water usage in new development

[32] CIRIA (2010) Culvert Design and Operation Guide. CIRIA report C689

[33] UK Climate Change Impacts Programme, Identifying adaptation options http://www.ukcip.org.uk/wordpress/wp-content/PDFs/ID_Adapt_options.pdf

- Building/designing property and buildings to minimise over-heating in summer months through the use of green space and running water.
- Reducing the consequences of flooding (increasing resilience) through the use of water-resistant materials for floors, walls and fixtures, and the sitting of electrical controls, cables and appliances at a higher than normal level.

Such options will require investments but overall are at least cost neutral when the immediacy of the targeted risks and realised benefits are considered.

Low-regrets options

Low-regret adaptation options include actions or activities that directly target the consequences of climate change but have a low relative cost. Those relevant to the FRA include:

- Building extra climate headroom in new developments to allow for further modifications (e.g. increased drainage and increased finished floor level)
- Restricting the type and extent of development in flood-prone areas
- Promoting the creation and preservation of space (e.g. verges, agricultural land, and green urban areas, including roofs) in support of additional temporary storage of runoff or flood water.
- Sharing in developing and operating additional water storage facilities (e.g. Community groups, Local Flood Risk Management partnership working arrangements to identify and implement measures).
- Improving the flood resilience of critical infrastructure, when it is renewed (such as electricity sub stations).

Both no- and low-regrets options have merit in that they are directed at maximising the return on investment when certainty of the associated risk is low.

Win-Win options

Win-win adaptation options are measures that have the desired result in terms of minimising the climate risks or exploiting potential opportunities but also have other social, environmental or economic benefits.

- Flood management that includes creating or re-establishing flood plains which increase flood management capacity and support biodiversity and habitat conservation objectives;
- Improving preparedness and contingency planning to deal with risks (including climate);
- Green roofs and green walls which have multiple benefits in terms of reducing building temperature and rainfall runoff from buildings, and increased green spaces within urban areas, but also reduces energy use for both heating and cooling.
- Flood mitigation measures that also contribute to improved water quality within the catchment (e.g. SuDS measures that improve the quality of discharges to the watercourses)

Flexible or adaptive management options

Flexible or adaptive management adaptation options involve putting in place incremental adaptation options, rather than undertaking large-scale adaptation in one fell swoop. Measures are introduced through an assessment of what is appropriate today, but are designed to allow for incremental change, including changing tack, as knowledge, experience and technology evolve.

Examples of flexible or adaptive management adaptation options that are relevant to the FRA include:

- Delay implementing specific adaptation measures while improving understanding of risk
- Introducing progressive withdrawal from areas at risk of flooding and creation or re-establishment of floodplains consistent with risks and development lifetimes
- Progressive development and investments in adaptation measures consistent with projected changes in climate (e.g. progressive investments in defence maintenance and level rising to maintain status quo).

Flexible or adaptive management options are perhaps the most important to plan ahead of time and should be a key feature of any local flood risk management plan. By identifying this type of opportunity early on it is possible to invest in a flexible plan of action and avoid repetition of work

each time the scheme or measure is reviewed. Such measures also allow for careful financial management of the funding which should spread the whole life cost across a number of different funding streams as they become available.

5.11.2 Mitigation measures

New development and re-development present an important opportunity to 'design-in' capacity for climate change mitigation into new development. The key opportunity is to build in additional capacity into systems to counter the predicted effects of climate change.

By requiring sites to mitigate today for the effects of 100 years of climate change it has the additional benefit of introducing local capacity in the present day systems. The mitigation schemes that include provision for the level of service, which will be required in 100 years, will provide an augmented level of service under present day conditions.

6 Summary and conclusions

This Neighbourhood Development Plan FRA document summarises the relevant policy and legislation with regards to planning and flood risk management.

25 proposed development sites within the Berinsfield neighbourhood plan boundary have been assessed for their current and future risk of flooding from rivers, surface water, groundwater and sewers.

The FRA provides general advice for planners and developers on:

- Sources of information within the Flood Map
- Flood risk from each source of flooding at each of the proposed sites
- What would be required from a site specific FRA, and what the implications for development would be

Developers should use the most up to date information for site specific Flood Risk Assessments and undertaking the Sequential Test. The Environment Agency is constantly undertaking flood modelling and mapping studies, and updates to the Flood Map are made quarterly.

The Neighbourhood Plan offers an opportunity for the Berinsfield community to ensure development provides improvements to flood risk overall and enhancements to their environment.

7 References

Legislation and government guidance

The Flood Risk Regulations (2009)

http://webarchive.nationalarchives.gov.uk/20140328084622/http://www.legislation.gov.uk/uksi/2009/3042/contents/made

The EU Floods Directive (2007)

http://ec.europa.eu/environment/water/flood_risk/index.htm

Flood and Water Management Act (2010)

http://www.legislation.gov.uk/ukpga/2010/29/contents

The EU Water Framework Directive (2000)

http://ec.europa.eu/environment/water/water-framework/index_en.html

Localism Act (2011)

http://www.legislation.gov.uk/ukpga/2011/20/part/6/chapter/3/enacted

National Planning Policy Framework, Department of Communities and Local Government (2012)

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/6077/2116950.pdf

Technical Guidance to the National Planning Policy Framework, Department of Communities and Local Government (2012)

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/6000/2115548.pdf

Improving the Flood Performance of New Buildings: Flood Resilient Construction, Department of Communities and Local Government (2007)

http://www.planningportal.gov.uk/uploads/br/flood_performance.pdf

Defra (March 2010) Surface Water Management Plan Technical Guidance

https://www.gov.uk/government/publications/surface-water-management-plan-technical-guidance

Lead Local Flood Authority flood risk management documents

Oxfordshire County Council Draft Local Flood Risk Management Strategy

https://www.oxfordshire.gov.uk/cms/content/oxfordshire-local-flood-risk-management-strategy

Oxfordshire County Council Preliminary Flood Risk Assessment (June 2011)

https://www.oxfordshire.gov.uk/cms/content/oxfordshire-preliminary-flood-risk-assessment-pfra

District council planning policy documents

Strategic Flood Risk Assessment (July 2013)

http://www.southoxon.gov.uk/services-and-advice/planning-and-building/planning-policy/evidence-studies/district-flood-risk

South Oxfordshire Development Plan

http://www.southoxon.gov.uk/services-and-advice/planning-and-building/planning-policy/our-development-plan

South Oxfordshire District Council Core Strategy (December 2012)

http://www.southoxon.gov.uk/services-and-advice/planning-and-building/planning-policy/core-strategy/adopted-core-strategy

South Oxfordshire Local Plan 2011. Strike-through version on adoption of South Oxfordshire Core Strategy December 2012

http://www.southoxon.gov.uk/services-and-advice/planning-and-building/planning-policy/local-plan/local-plan-2011

Environment Agency resources and guidance

Environment Agency, Risk of flooding from reservoirs map

http://maps.environment-agency.gov.uk/wiyby/wiybyController?x=357683.0&y=355134.0&scale=1&layerGroups=default&ep=map&textonly=off&lang=_e&topic=reservoir

Environment Agency, Flood Map (Risk of flooding from rivers and the sea)

http://maps.environment-agency.gov.uk/wiyby/wiybyController?x=357683.0&y=355134.0&scale=1&layerGroups=default&ep=map&textonly=off&lang=_e&topic=floodmap

Environment Agency Flood Risk Standing Advice

http://www.environment-agency.gov.uk/research/planning/82584.aspx

Environment Agency, FRA Guidance Note 1

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http://www.ciria.org/ItemDetail?iProductCode=C624&Category=BOOK

CIRIA (2007) The SuDS Manual (C697) (can be purchased at www.ciria.org)

CIRIA (2010) Culvert Design and Operation Guide. CIRIA report C689 (available free by registering at www.ciria.org)

CIRIA (2012) Retrofitting for surface water management (C713) (can be purchased at www.ciria.org)

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Appendices

A Potential development area flood risk summary sheets

A.1 Introduction

The following section includes a summary of each of the suggested sites put forward to SODC. The information given is based on national mapping provided by the Environment Agency and SODC. It should provide enough detailed information to carry out the Sequential Test as outlined in the NPPF Technical Guidance.

The following points should be taken into account when interpreting the maps.

- Flood Zone 3a and Flood Zone 2 are based on the national mapping provided by the Environment Agency.
- Flood Zone 3b was not provided by the Environment Agency. Where no detailed modelling information is available a precautionary approach is taken and Flood Zone 3b is equivalent to Flood Zone 3a. This is the case for the sites within Berinsfield. Note that for detailed model information (e.g. River Thames model) Flood Zone 3b would be based on the 20 year flood extent.
- The Flood Map supplied by the Environment Agency does not include a layer for climate change impact. Here we have taken the same approach as in the SFRA. Where no detailed modelling information is available a precautionary approach has been taken and it is assumed that the Flood Zone 2 outline represents Flood Zone 3 with climate change. Where detailed modelling is available (i.e. River Thames model) the 1 in 100 year plus 20% climate change modelled flood extent is used.
- The updated Flood Map for Surface Water (uFMfSW) shows the flood extent as a result of rainfall with a 1 in 30, 100 and 1000 chance of occurring in any given year. The Environment Agency advices that the results should not be used to understand flood risk for individual properties but rather at a street level. Within the summary sheets the risk of flooding from surface water has been classified as follows:
    - Very Low - the area has a chance of flooding less than 1 in 1000 (0.1%)
    - Low - the area has a chance of flooding of between 1 in 1000 (0.1%) and 1 in 100 (1%)
    - Medium - this area has a chance of flooding of between 1 in 100 (1%) and 1 in 30 (3.3%).
    - High - this area has a chance of flooding greater than 1 in 30 (3.3%).
- The Areas Susceptible to Groundwater Flooding (AStGWF) map is very broad-scale (1km grid squares) and has not been shown for individual sites. It can be viewed in Figure 3-2.

The Environment Agency Flood Map is a combination of broad-scale lower confidence mapping with regions of detailed higher confidence mapping. In Berinsfield the Flood Map is composed of the River Thames Sandford to Whitchurch (Environment Agency, 2000) detailed hydraulic model and broad-scale mapping with a lower confidence for Burcot Brook and Elaine's Brook.

There is a more detailed model of Elaine's Brook (JBA, 2007) which is available from the Environment Agency for use in FRAs but has not been used within the Flood Maps due to lack of LIDAR data.

A.2 Berinsfield NDP summary sheets

A.2.1 Ber1

Site Name: Ber1

Area: 6.81 ha	**Brownfield/greenfield:** Greenfield

Summary of flood risk to site

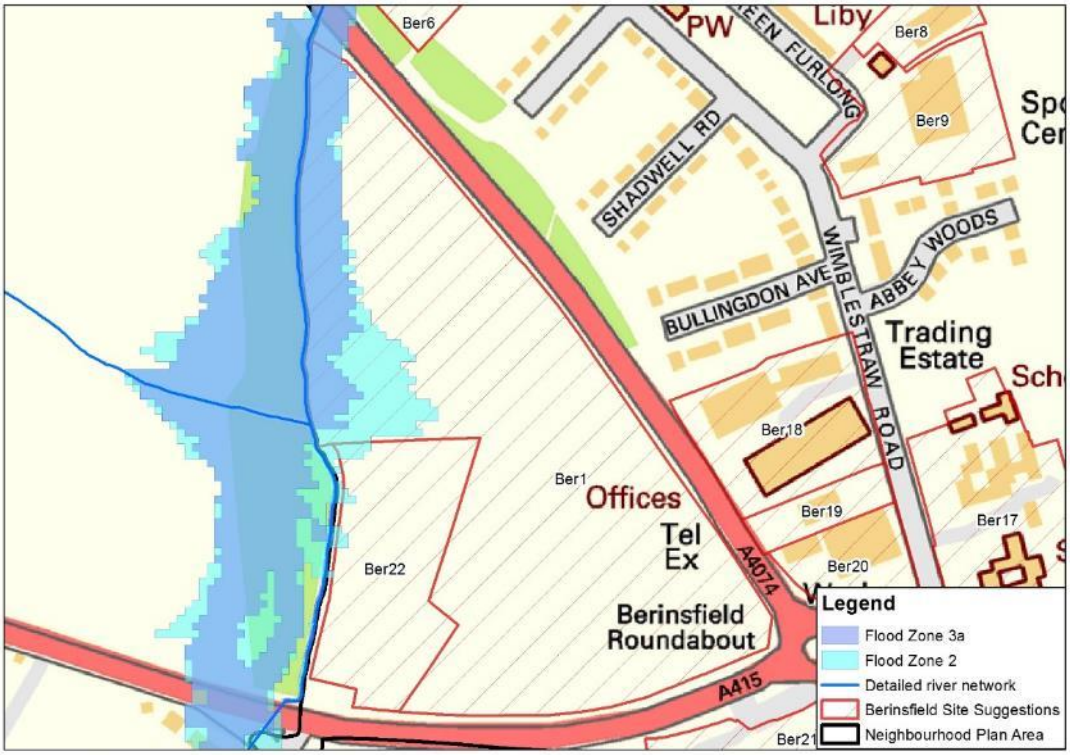
Fluvial

Burcot Brook flows from north to south along the western boundary of the site. Flood Zone 2 and 3 typically extend 30m into the site with Flood Zone 2 extending further into the centre of the site.

Flood zones have been produced using an older mapping technique

There are no formal flood defences.

Flood Zone map



Available survey/detailed modelling

No detailed model available. Burcot Brook broad-scale mapping.

Groundwater

The AStGWF map suggests the northern half of the site to be at medium risk from groundwater emergence, increasing to the highest category to the south, closer to the River Thames alluvial gravels.

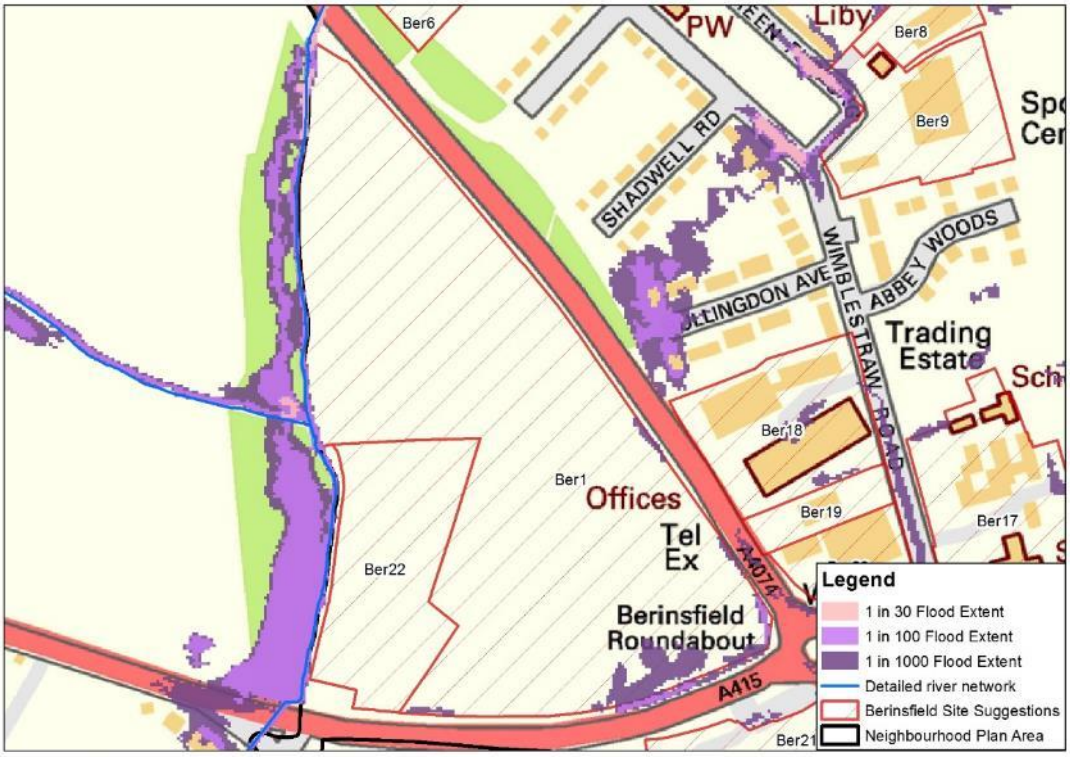
Sewer

No known problems (site is greenfield).

Surface water

The uFMfSW shows a flow path along the western edge of the site due to the presence of the Burcot Brook. There are also some areas of ponding, with the largest near the Berinsfield roundabout.

Updated Flood Map for Surface Water



Effects of climate change

Increased river flows will cause more frequent and more severe fluvial flooding from Burcot Brook. The Flood Zone 2 outline is larger in the centre of the site than Flood Zone 3a.

Increased rainfall intensity in the future may exacerbate flooding from surface water and small watercourses. Wetter winters may increase groundwater flood risk.

Implications for development

- Requires a full FRA for a site in Flood Zone 3.
- It must be demonstrated that the site will be designed sequentially ensuring all development will be outside of Flood Zone 2 with climate change.
- A sequential approach should be applied to the site layout with more flood-compatible development (e.g. recreational space) located in the more high risk areas.
- It must be demonstrated that safe, dry access and egress will be available during a severe flood event.
- FRA should include a detailed assessment of groundwater flood risk.
- Space for flooding to occur should be allocated and opportunities to enhance the amenity value of the area should be considered.
- The development must not increase existing flood risk in the area or downstream. A drainage strategy should be submitted at an early stage to cover mitigation of any surface water risk and reduce impact downstream through site design and SUDS methods. Runoff less than greenfield rates is desirable.
- Thames Water should be consulted at an early stage to ensure that there will be sufficient capacity in the wastewater system and any upgrades are carried out where necessary.

A.2.2 Ber2

Site Name: Ber2

Area: 0.67 ha	**Brownfield/greenfield:** Greenfield

Summary of flood risk to site

Fluvial

There is no known risk from fluvial flooding.

There are no formal flood defences.

Flood Zone map

Available survey/detailed modelling

No detailed model available.

Groundwater

The AStGWF map shows the site to be within the highest category of groundwater emergence due to its proximity to the River Thames alluvial gravels.

Sewer

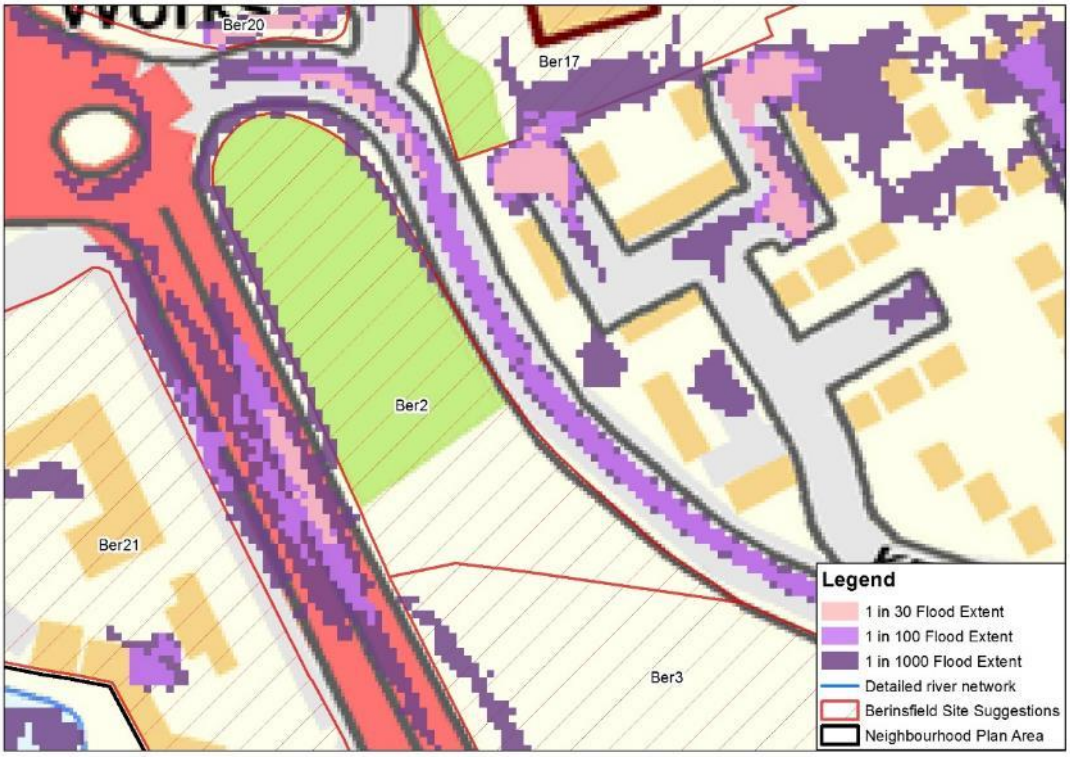
No known problems (site is greenfield).

Surface water

The uFMfSW shows the edges of the site are at low risk of flooding from surface water.

Updated Flood Map for Surface Water

Updated Flood Map for Surface Water



Effects of climate change

Increased rainfall intensity in the future may exacerbate any surface water flooding problems. Wetter winters may increase groundwater flood risk.

Implications for development

- Does not require a full FRA for a site <1ha in Flood Zone 1 (as long as there is not a known drainage issue).
- Developer and local authority should seek to reduce the potential increase to flood risk elsewhere through the layout of the development and use of appropriate SuDS.
- Aim to achieve greenfield discharge rates
- Risk from groundwater flooding should be considered

A.2.3 Ber3

Site Name: Ber3

Area: 6.92 ha	**Brownfield/greenfield:** Greenfield

Summary of flood risk to site

Fluvial

Flood Zone 2 and 3 covers approximately 80 and 60% of the site respectively. The source of the fluvial flooding is from Elaine's Ditch. The water exceeds the channel capacity and flows across Burcot Lane into the site.

There are no formal flood defences.

Flood Zone map

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Available survey/detailed modelling

No detailed model available. Elaine's Ditch broad-scale mapping.

Groundwater

The AStGWF map shows the site to be within the highest category of groundwater emergence due to its proximity to the River Thames alluvial gravels.

Sewer

No known problems (site is greenfield).

Surface water

The uFMfSW shows a large proportion of the site has a low potential to pond surface water.

Updated Flood Map for Surface Water

Effects of climate change

Increased river flows will cause more frequent and more severe fluvial flooding from Elaine's Ditch. The Flood Zone 2 outline is significantly larger in area than Flood Zone 3a. Most of the site will be affected by the 1 in 100 year fluvial event when climate change is taken account of.

Increased rainfall intensity in the future may exacerbate any surface water flooding problems.

Wetter winters may increase groundwater flood risk.

Implications for development

- Requires a full FRA for a site in Flood Zone 3.
- It must be demonstrated that the site will be designed sequentially ensuring all development will be outside of Flood Zone 2 with climate change. Since most of the site is covered by Flood Zone 3a, the FRA should demonstrate that the development will not be at risk from Elaine's Brook, through detailed modelling if necessary.
- FRA should include a detailed assessment of groundwater flood risk.
- It must be demonstrated that safe, dry access and egress will be available during a severe flood event.
- The development must not increase existing flood risk of the surrounding area. A drainage strategy should be submitted at an early stage to cover mitigation of any surface water risk and reduce impact downstream through site design and SUDS methods. Runoff less than greenfield rates is desirable.
- Thames Water should be consulted at an early stage to ensure that there will be sufficient capacity in the wastewater system and any upgrades are carried out where necessary.

A.2.4 Ber4

Site Name: Ber4

Area: 33.2 ha | **Brownfield/greenfield:** Mixed

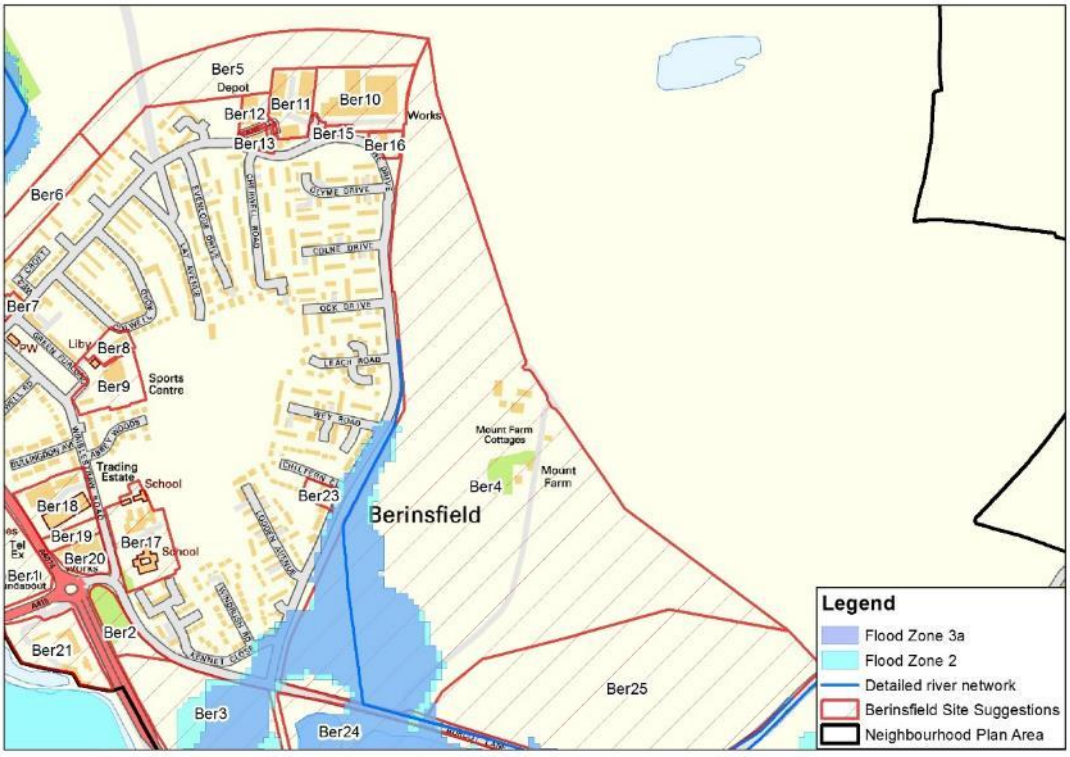
Summary of flood risk to site

Fluvial

The south west corner of the site is at risk from fluvial flooding from Elaine's Ditch. The watercourse runs from north to south along the west of the site before cutting directly south across the site. There is little difference in Flood Zone 2 and 3 extents.

There are no formal flood defences.

Flood Zone map



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Available survey/detailed modelling

No detailed model available. Elaine's Ditch broad-scale mapping.

Groundwater

The AStGWF map suggests the northern half of the site to be at a medium risk from groundwater emergence, increasing to the highest category to the south, closer to the River Thames alluvial gravels.

Sewer

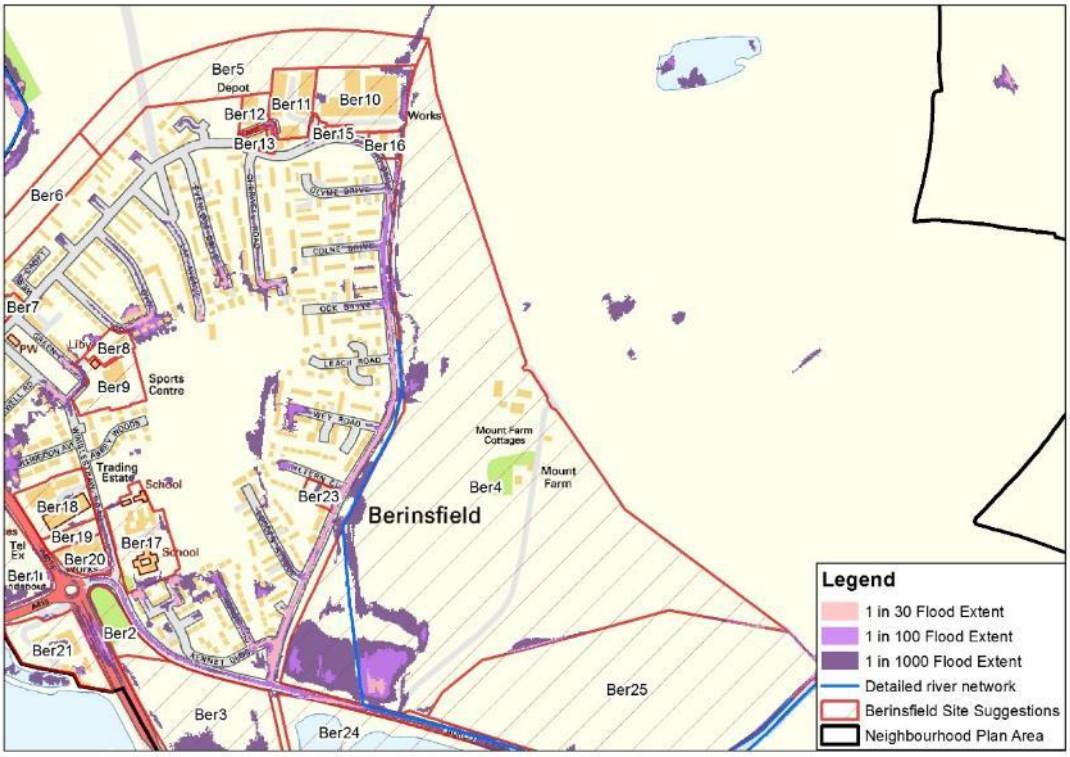
The OX10 7 postcode has 8 properties on the Thames Water register, including 3 at risk of internal flooding, but it is not known where these properties are. No other evidence found of sewer flooding.

Surface water

The uFMfSW shows a potential flow path along the western boundary of the site which coincides with Elaine's Ditch. It also shows other areas of ponding, the most significant being in the south of the site and where the graveyard is located.

There is a flow path for a 1 in 30 year rain event or worse along the full length of Fane Drive adjacent to the site and further surface water ponding predicted along Burcot Lane.

Updated Flood Map for Surface Water



Effects of climate change

Climate change is unlikely to increase the fluvial flood extent significantly (there is little difference between the Flood Zone 2 and 3 outlines).

Increased rainfall intensity in the future may exacerbate any surface water flooding problems.

Wetter winters may increase groundwater flood risk.

Implications for development

- Requires a full FRA for a site in Flood Zone 3.
- It must be demonstrated that the site will be designed sequentially ensuring all development will be outside of Flood Zone 2 with climate change and in the south of the site which is at highest risk from surface water flooding and groundwater emergence.
- FRA should include a detailed assessment of groundwater flood risk.
- It must be demonstrated that safe, dry access and egress will be available during a severe flood event from multiple access points.
- Space for flooding to occur should be allocated and opportunities to enhance the amenity value of the area should be considered.
- The development must not increase existing flood risk downstream. A drainage strategy should be submitted at an early stage to cover mitigation of any surface water risk and reduce impact downstream through site design and SUDS methods. Runoff less than greenfield rates is desirable.
- Thames Water should be consulted at an early stage to ensure that there will be sufficient capacity in the wastewater system and any upgrades are carried out where necessary.

A.2.5 Ber5

Site Name: Ber5	
Area: 4.31 ha	**Brownfield/greenfield:** Greenfield

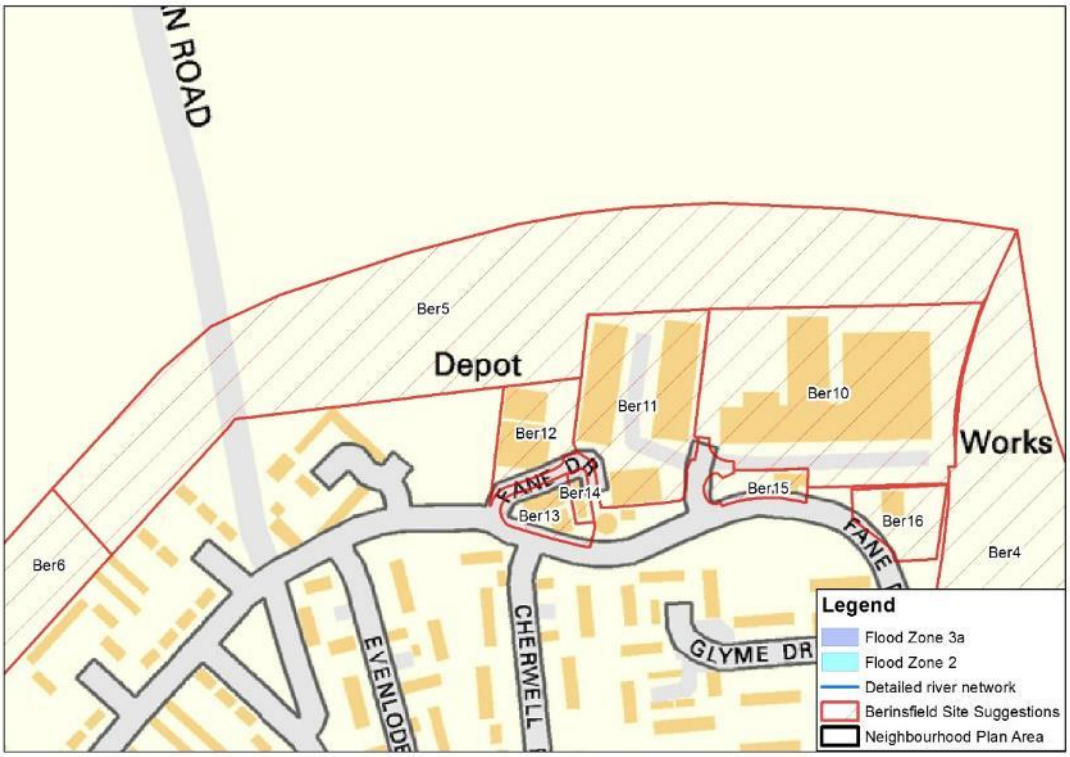
Summary of flood risk to site

Fluvial

There is no known risk from fluvial flooding.

There are no formal flood defences.

Flood Zone map



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Available survey/detailed modelling

No detailed model available.

Groundwater

The AStGWF map shows the site is at medium risk of groundwater emergence.

Sewer

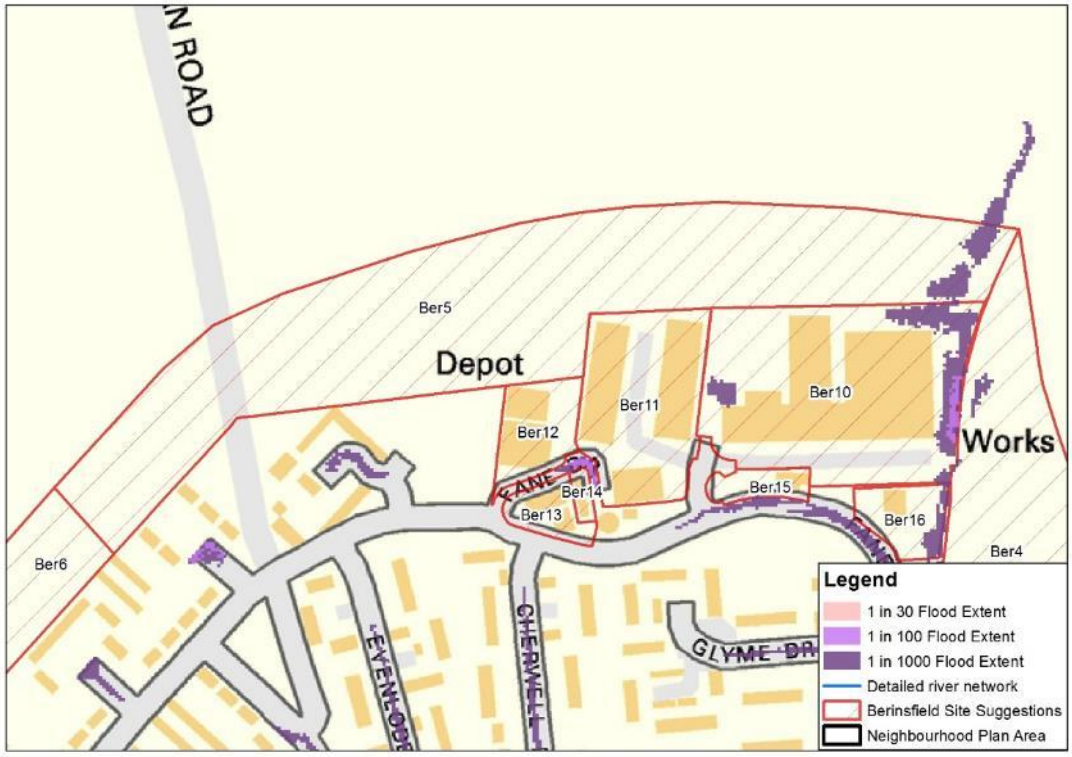
No known problems (site is greenfield).

Surface water

The uFMfSW shows a small area in the east of the site has a low potential of ponding.

Updated Flood Map for Surface Water

Updated Flood Map for Surface Water



Effects of climate change

Increased rainfall intensity in the future may exacerbate any surface water flooding problems.

Implications for development

- Requires a full FRA for a site >1ha in Flood Zone 1.
- Drainage strategy should be submitted at an early stage to cover mitigation of any surface water risk and reduce impact downstream through site design and SUDS methods.
- Thames Water should be consulted at an early stage to ensure that there will be sufficient capacity in the wastewater system and any upgrades are carried out where necessary.

A.2.6 Ber6

Site Name: Ber6

Area: 2.53 ha	**Brownfield/greenfield:** Greenfield

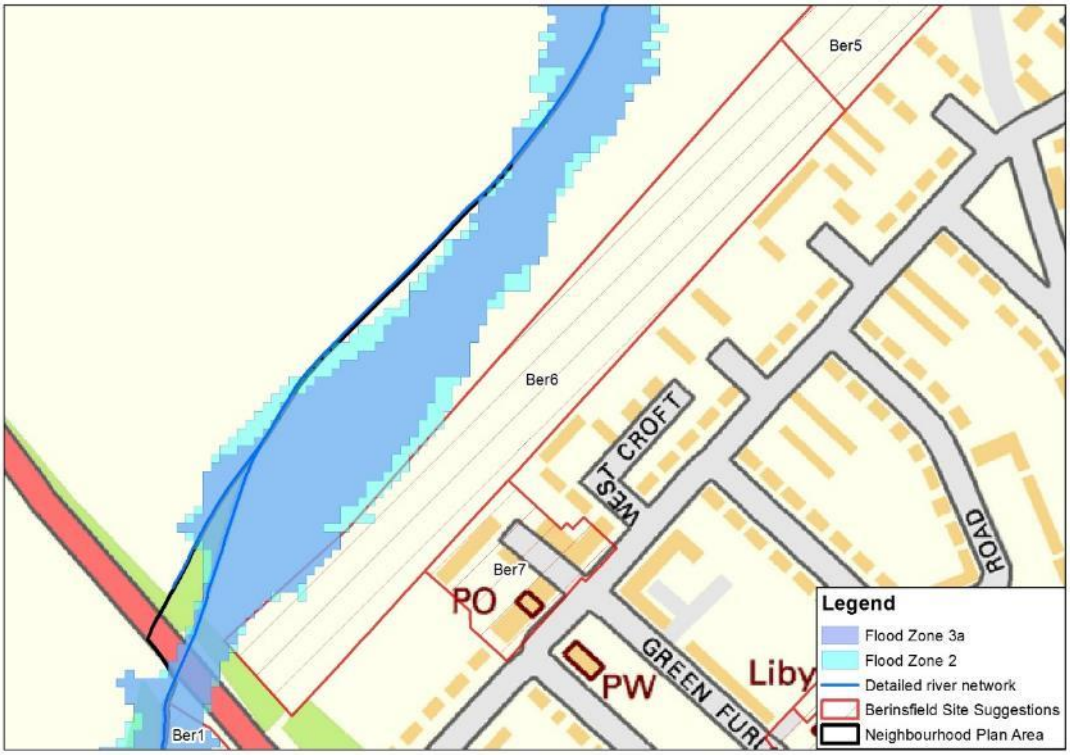
Summary of flood risk to site

Fluvial

Burcot Brook flows from the north east to the south west parallel to the site boundary. Flood Zones 2 and 3 are immediately adjacent to the west of the site and there is a small risk of fluvial flooding along in the south west of the site.

There are no formal flood defences.

Flood Zone map



Available survey/detailed modelling

No detailed model available. Burcot Brook broad-scale mapping.

Groundwater

The AStGWF map shows the site is at medium risk of groundwater emergence.

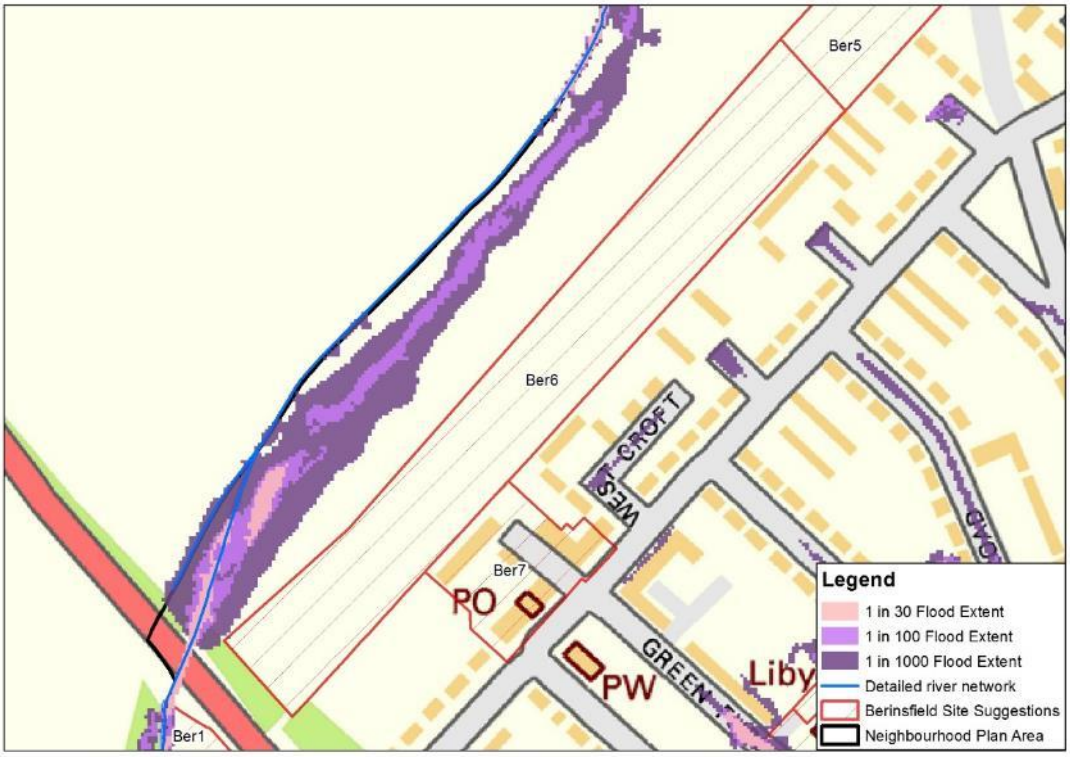
Sewer

No known problems (site is greenfield).

Surface water

The uFMfSW shows the site is at low risk from surface water. A flow path associated with Burcot Brook is located to the east of the site.

Updated Flood Map for Surface Water



Effects of climate change

Climate change is likely to increase the fluvial flood extent from the Burcot Brook enough to place the eastern edge of the site within the 1 in 100 year flood extent.

Implications for development

- Requires a full FRA for a site in Flood Zone 3.
- It must be demonstrated that the site will be designed sequentially ensuring all development will be outside of Flood Zone 2 with climate change.
- It must be demonstrated that safe, dry access and egress will be available during a severe flood event.
- Drainage strategy should be submitted at an early stage to cover mitigation of any surface water risk and reduce impact downstream through site design and SUDS methods.
- Thames Water should be consulted at an early stage to ensure that there will be sufficient capacity in the wastewater system and any upgrades are carried out where necessary.

A.2.7 Ber7

Site Name: Ber7

Area: 0.56 ha	**Brownfield/greenfield:** Brownfield

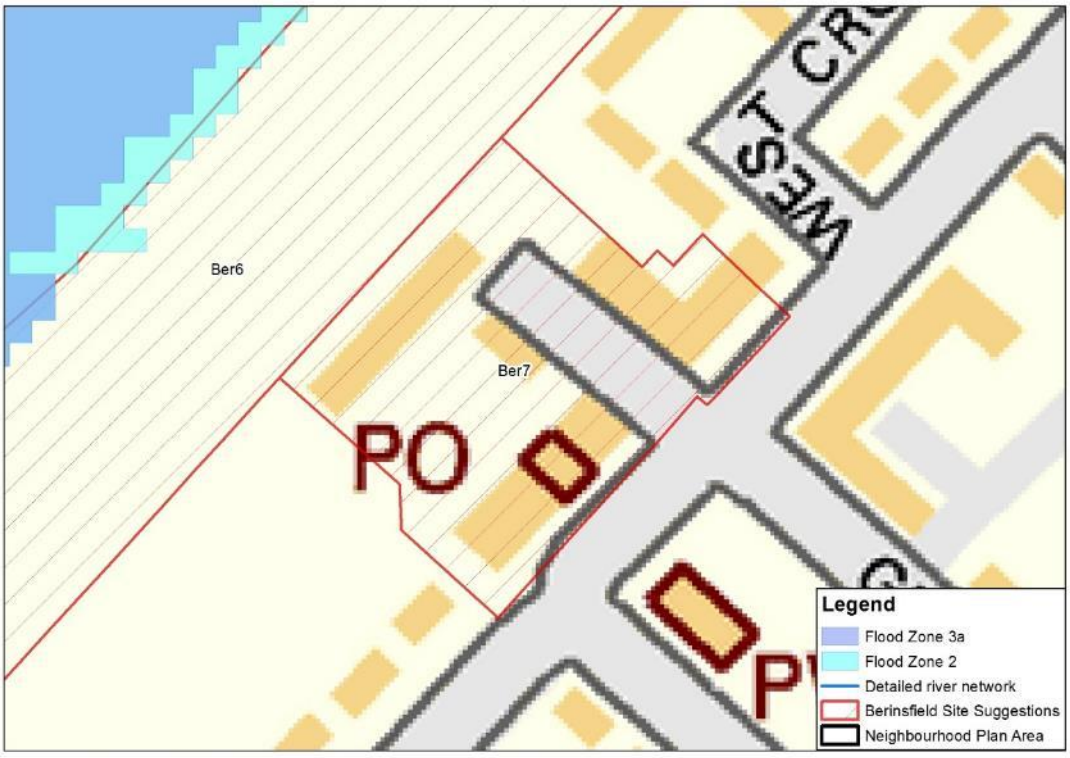
Summary of flood risk to site

Fluvial

There is no known risk from fluvial flooding. Burcot Brook Flood Zones are approximately 50m to the north west.

There are no formal flood defences.

Flood Zone map



Available survey/detailed modelling

No detailed model available. Burcot Brook broad-scale mapping.

Groundwater

The AStGWF map shows the site is at medium risk of groundwater emergence.

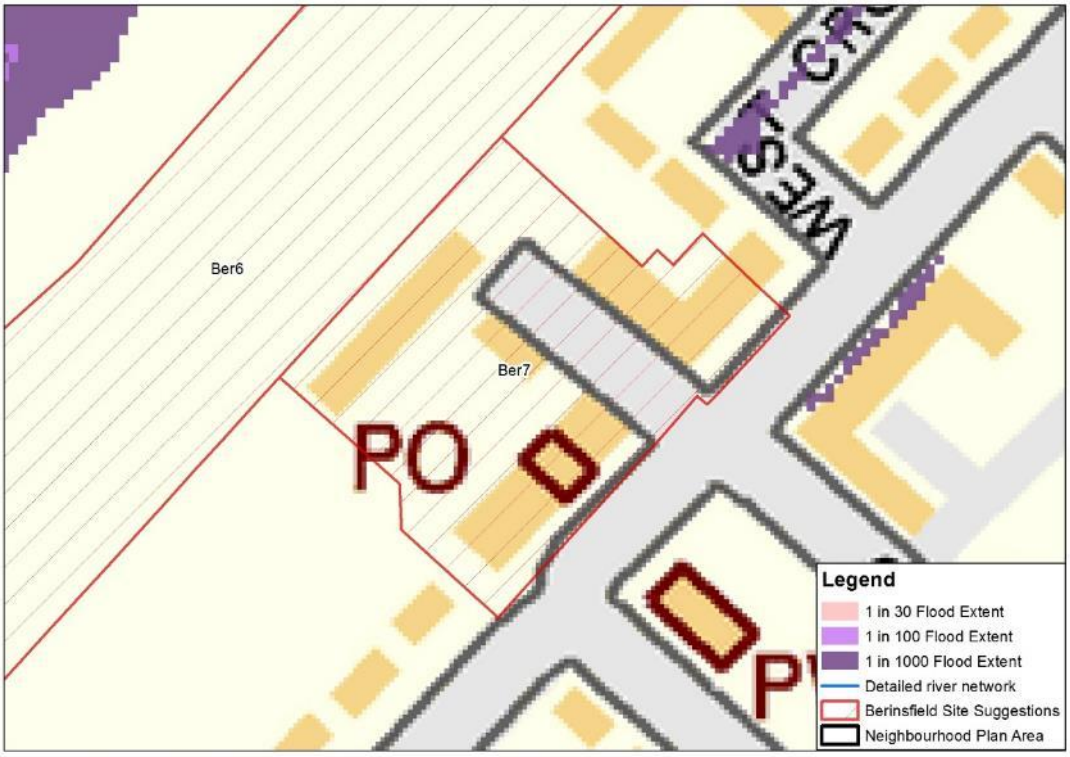
Sewer

The OX10 7 postcode has 8 properties on the Thames Water register, including 3 at risk of internal flooding, but it is not known where these properties are. No other evidence found of sewer flooding.

Surface water

uFMfSW shows the site is at very low risk from surface water.

Updated Flood Map for Surface Water



Effects of climate change

Flood risk is not expected to increase noticeably.

Implications for development

- Does not require a full FRA for a site <1ha in Flood Zone 1 (as long as there is not a known drainage issue).
- Aim to reduce runoff rates from the site compared with the previous usage through development layout and use of appropriate SuDS.

A.2.8 Ber8

Site Name: Ber8

Area: 0.30 ha | **Brownfield/greenfield:** Brownfield

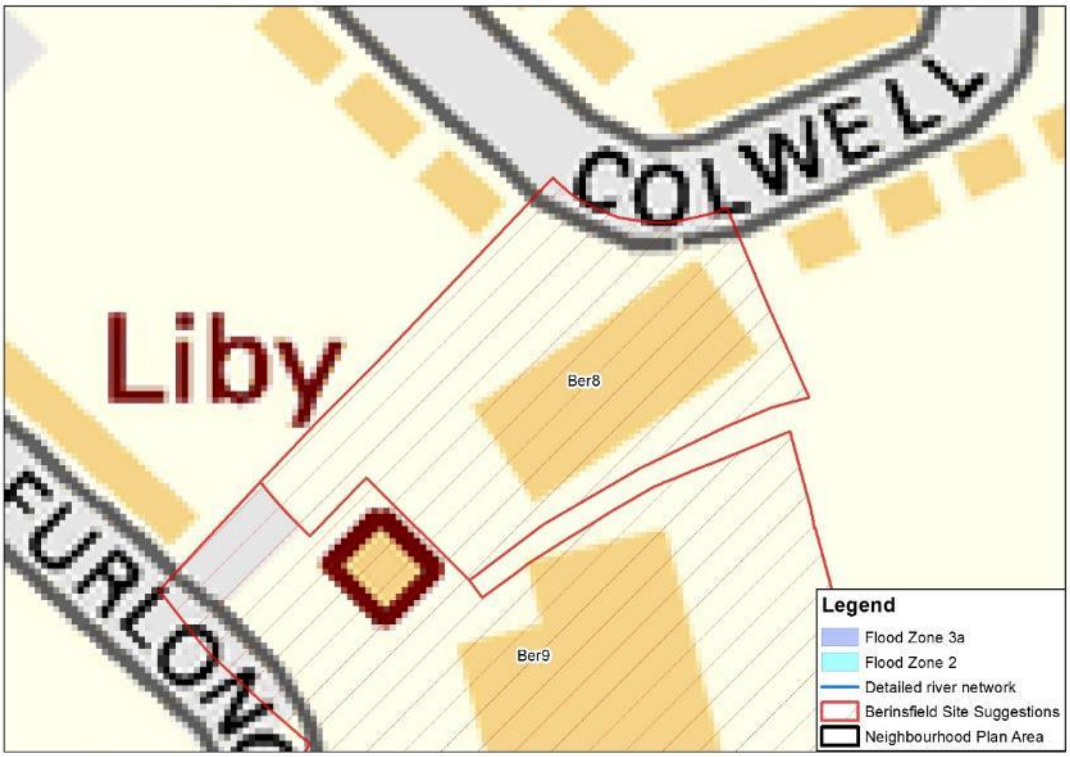
Summary of flood risk to site

Fluvial

There is no known risk from fluvial flooding.

There are no formal flood defences.

Flood Zone map



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Available survey/detailed modelling

No detailed model available.

Groundwater

The AStGWF map shows the site is at medium risk of groundwater emergence.

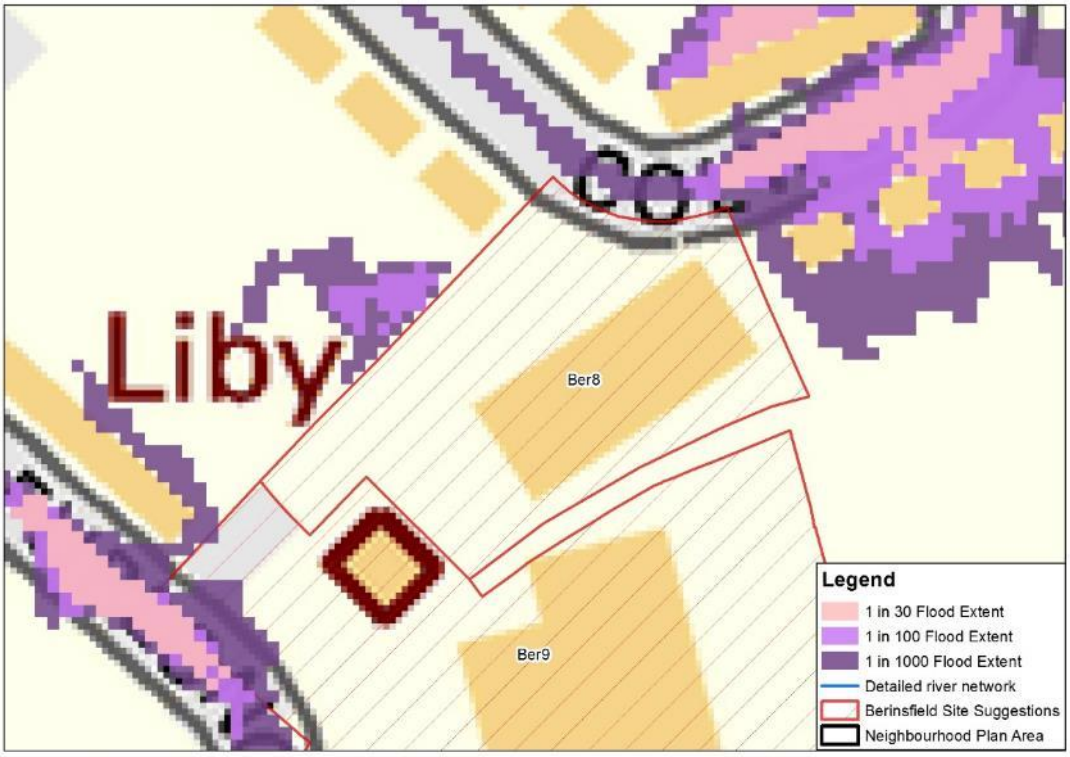
Sewer

The OX10 7 postcode has 8 properties on the Thames Water register, including 3 at risk of internal flooding, but it is not known where these properties are. No other evidence found of sewer flooding.

Surface water

uFMfSW shows the site is at very low risk from surface water.

Updated Flood Map for Surface Water



Effects of climate change

Increased rainfall intensity in the future may exacerbate any surface water flooding problems.

Implications for development

- Does not require a full FRA for a site <1ha in Flood Zone 1 (as long as there is not a known drainage issue).
- Aim to reduce runoff rates from the site compared with the previous usage through development layout and use of appropriate SuDS.

A.2.9 Ber9

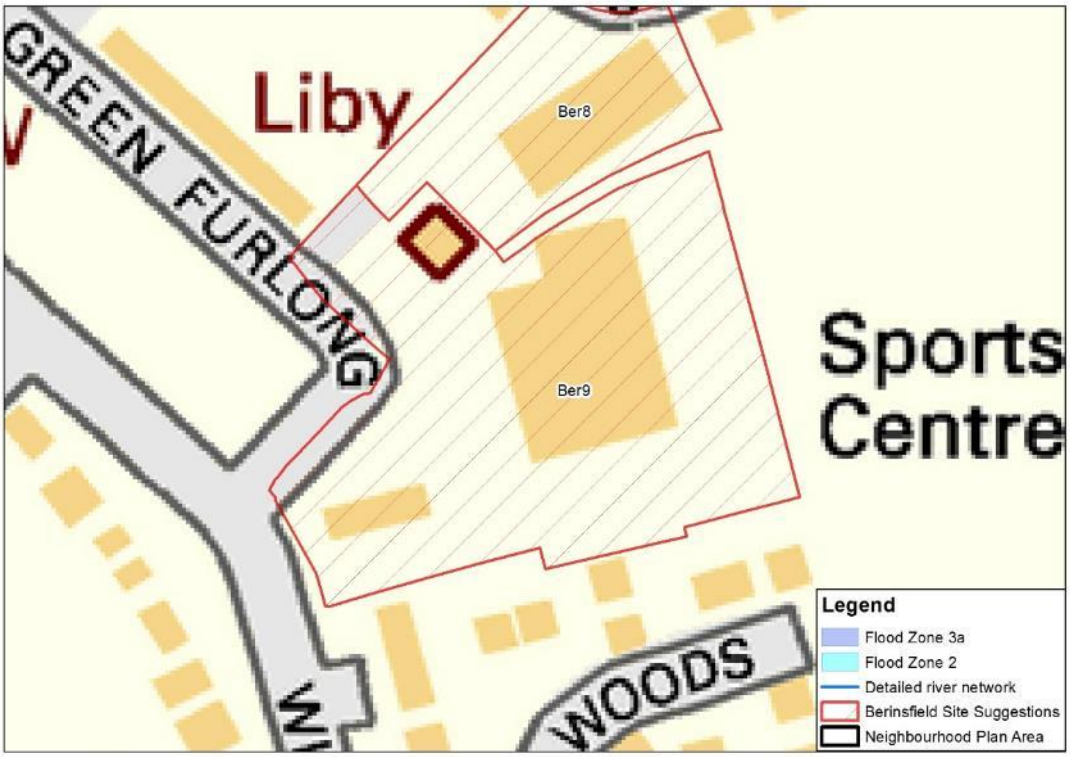
Site Name: Ber9	
Area: 0.95 ha	**Brownfield/greenfield:** Brownfield
Summary of flood risk to site	

Fluvial

There is no known risk from fluvial flooding.

There are no formal flood defences.

Flood Zone map



Available survey/detailed modelling

No detailed model available.

Groundwater

The AStGWF map shows the site is at medium risk of groundwater emergence.

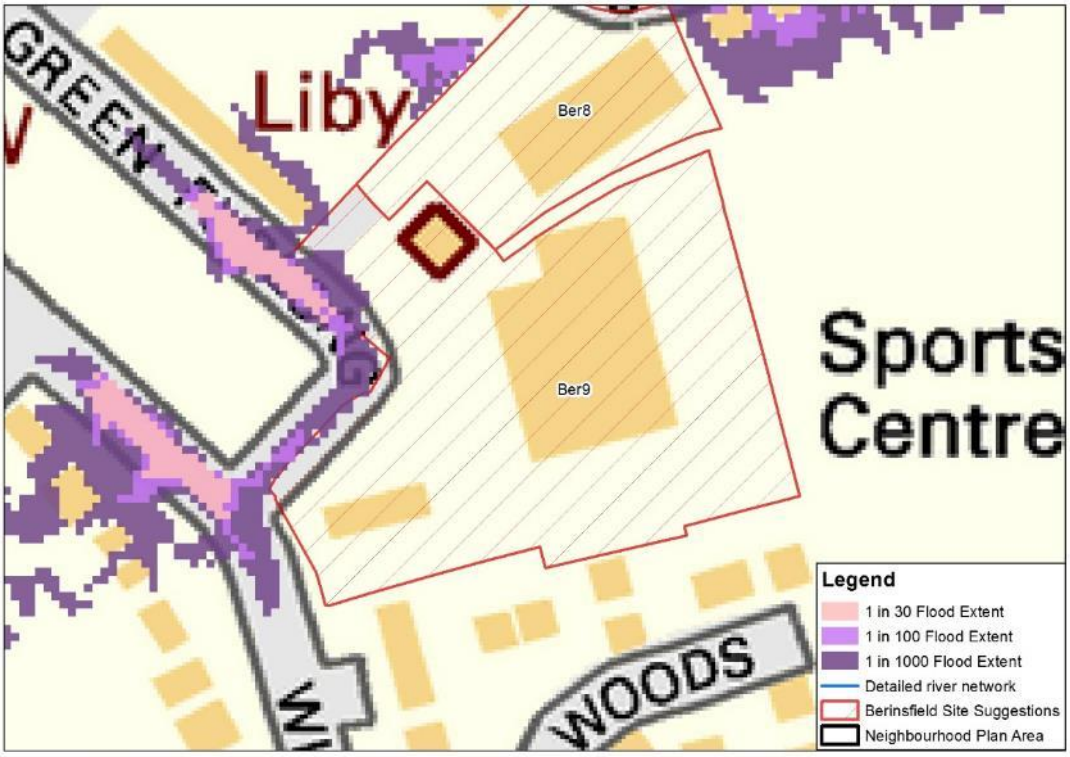
Sewer

The OX10 7 postcode has 8 properties on the Thames Water register, including 3 at risk of internal flooding, but it is not known where these properties are. No other evidence found of sewer flooding.

Surface water

The uFMfSW shows the site is at low risk from surface water flooding although the access to the site, Green Furlong, has a high potential to pond.

Updated Flood Map for Surface Water



Effects of climate change

Increased rainfall intensity in the future may exacerbate any surface water flooding problems.

Available survey/detailed modelling

No detailed model available.

Implications for development

- Does not require a full FRA for a site <1ha in Flood Zone 1 (as long as there is not a known drainage issue).
- Aim to reduce runoff rates from the site compared with the previous usage through development layout and use of appropriate SuDS.

A.2.10 Ber10

Site Name: Ber10

Area: 1.74 ha | **Brownfield/greenfield:** Brownfield

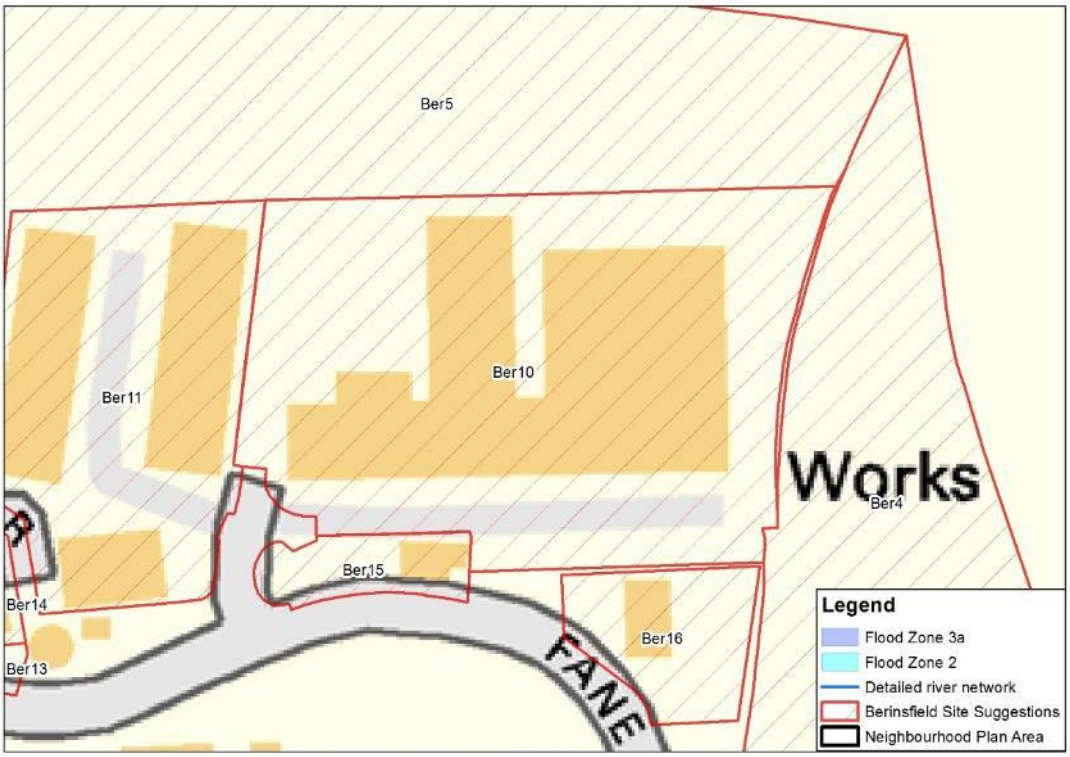
Summary of flood risk to site

Fluvial

There is no known risk from fluvial flooding.

There are no formal flood defences.

Flood Zone map



Available survey/detailed modelling

No detailed model available.

Groundwater

The AStGWF map shows the site is at medium risk of groundwater emergence.

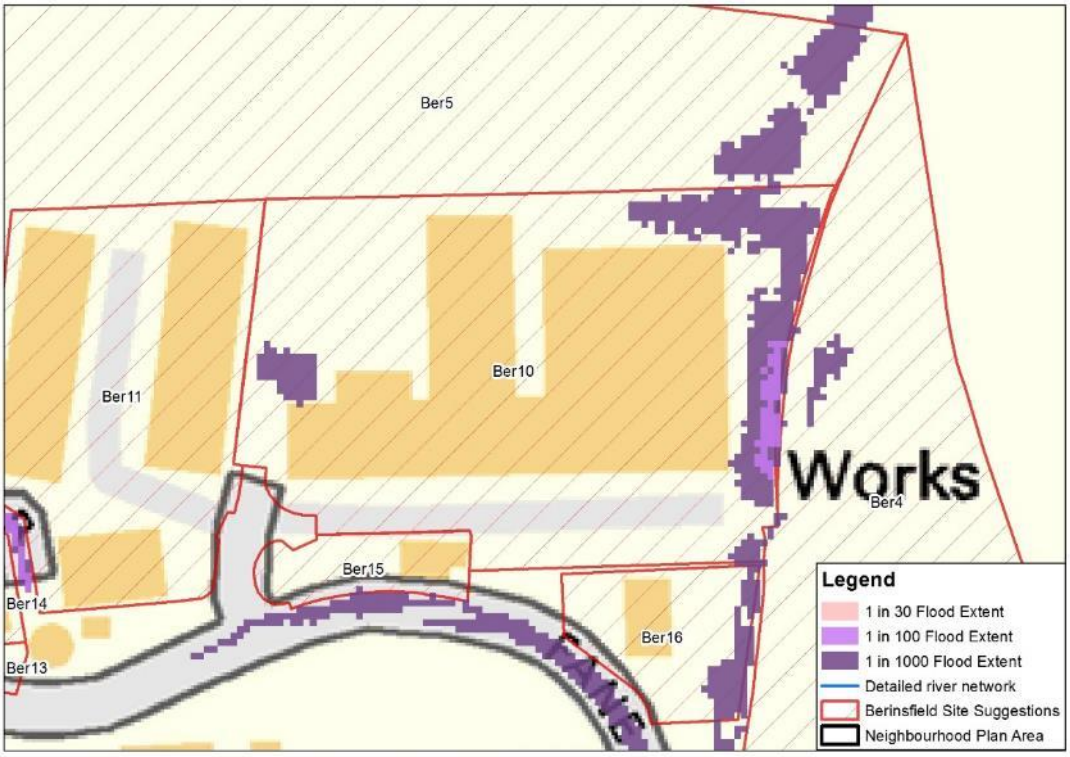
Sewer

The OX10 7 postcode has 8 properties on the Thames Water register, including 3 at risk of internal flooding, but it is not known where these properties are. No other evidence found of sewer flooding.

Surface water

The uFMfSW shows areas at low risk of potential ponding, with an area in the east of the site at medium risk of ponding.

Updated Flood Map for Surface Water



Effects of climate change

Increased rainfall intensity in the future may exacerbate any surface water flooding problems.

Implications for development

- Requires a full FRA for a site >1ha in Flood Zone 1.
- The FRA should consider the surface water flood risk in the east of the site and aim to reduce runoff to this flow path.
- The FRA should aim to reduce runoff rates from the site compared with the previous usage through development layout and use of appropriate SuDS.

A.2.11 Ber11

Site Name: Ber11

Area: 0.86 ha | **Brownfield/greenfield:** Brownfield

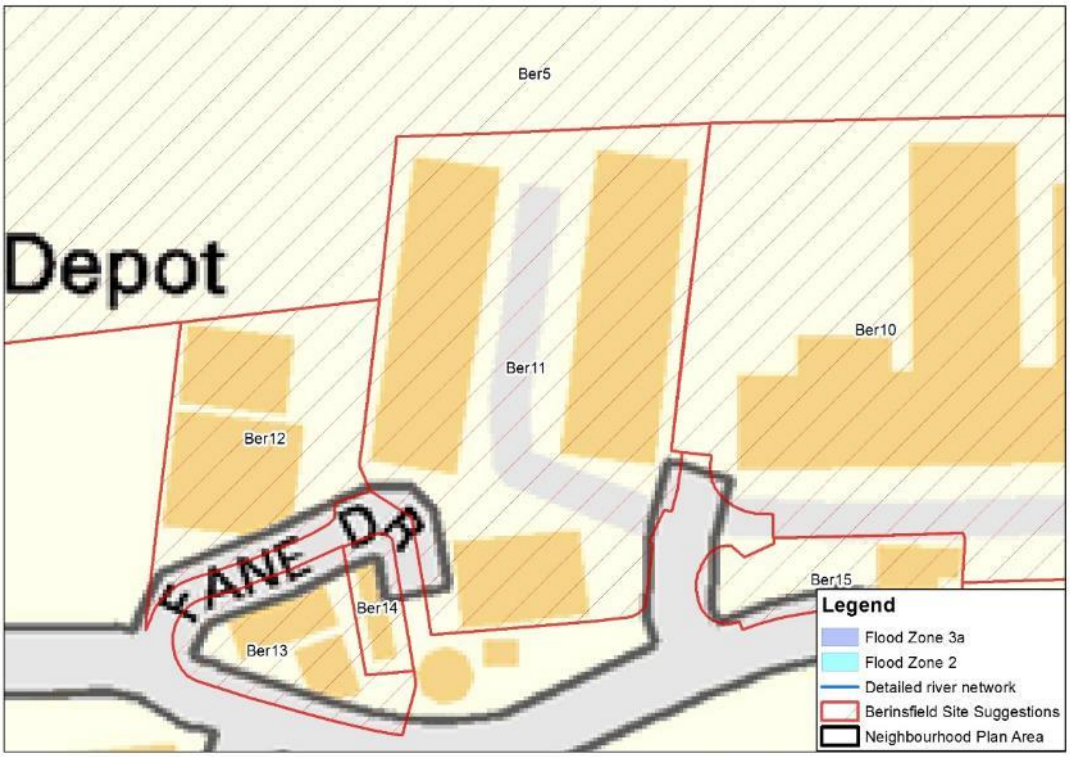
Summary of flood risk to site

Fluvial

There is no known risk from fluvial flooding.

There are no formal flood defences.

Flood Zone map



Available survey/detailed modelling

No detailed model available.

Groundwater

The AStGWF map shows the site is at medium risk of groundwater emergence.

Sewer

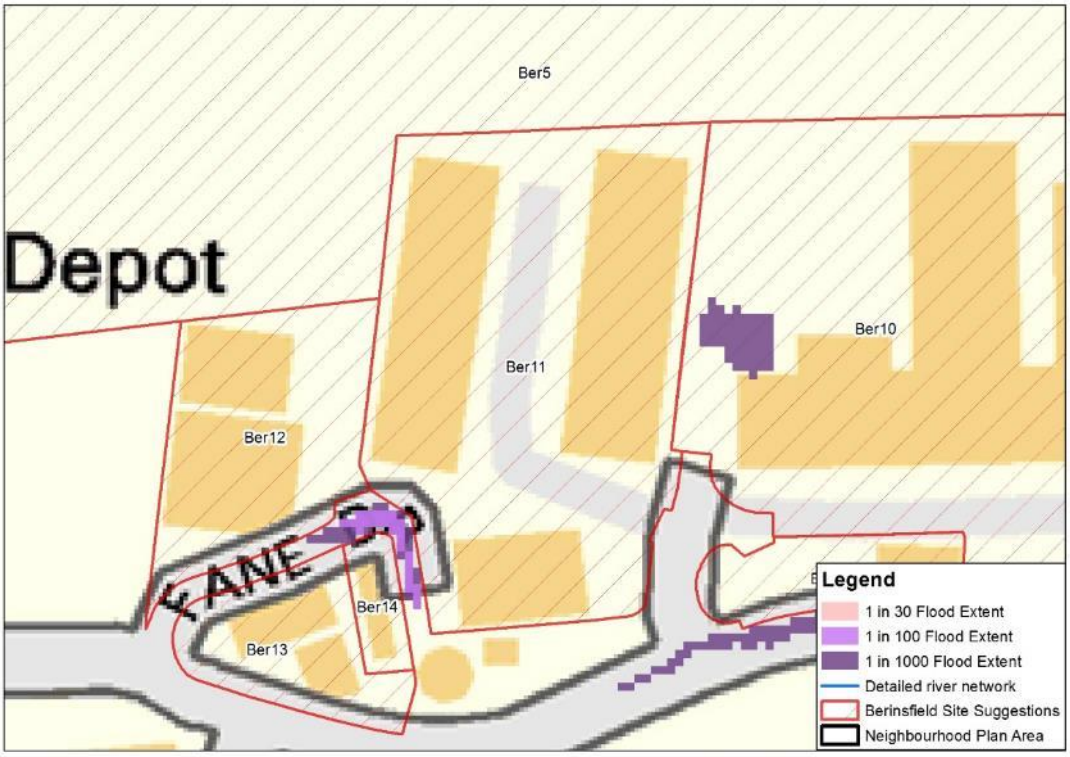
The OX10 7 postcode has 8 properties on the Thames Water register, including 3 at risk of internal flooding, but it is not known where these properties are. No other evidence found of sewer flooding.

Surface water

The uFMfSW shows the site to be at very low risk from surface water flooding.

Updated Flood Map for Surface Water

Updated Flood Map for Surface Water



Effects of climate change

Flood risk is not expected to increase noticeably.

Implications for development

- Does not require a full FRA for a site <1ha in Flood Zone 1 (as long as there is not a known drainage issue).
- Development should aim to reduce runoff rates from the site compared with the previous usage through development layout and use of appropriate SuDS.

A.2.12 Ber12

Site Name: Ber12	
Area: 0.29 ha	**Brownfield/greenfield:** Brownfield

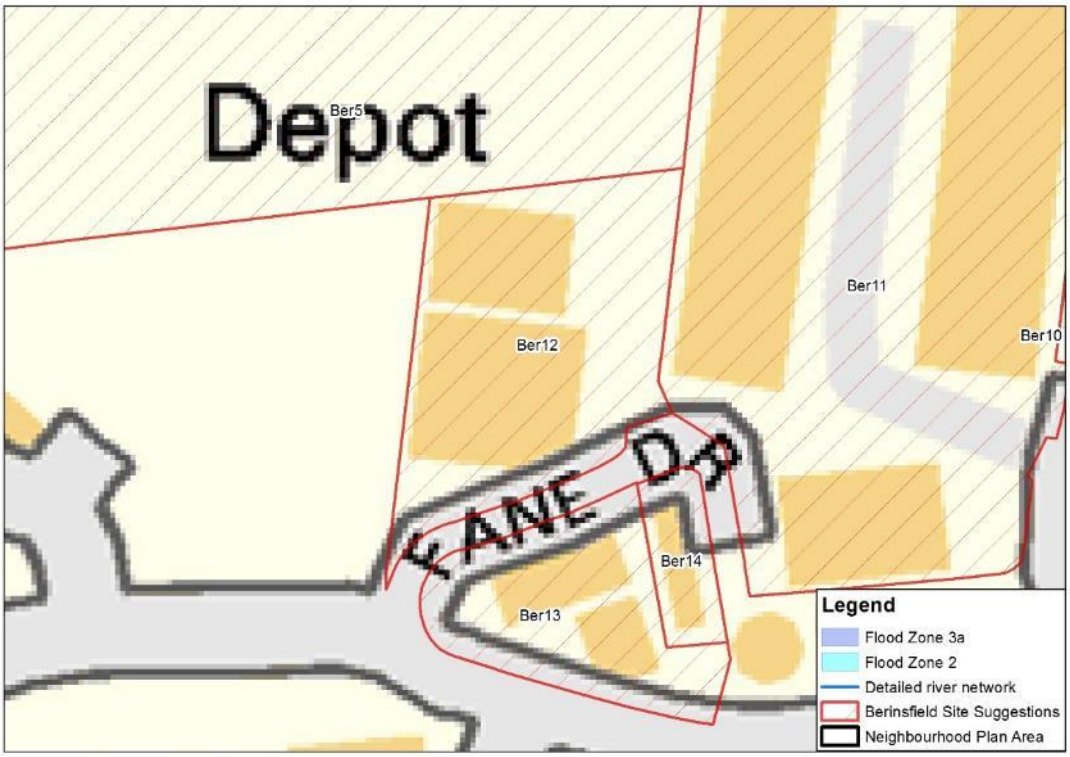
Summary of flood risk to site

Fluvial

There is no known risk from fluvial flooding.

There are no formal flood defences.

Flood Zone map



Available survey/detailed modelling

No detailed model available.

Groundwater

The AStGWF map shows the site is at medium risk of groundwater emergence.

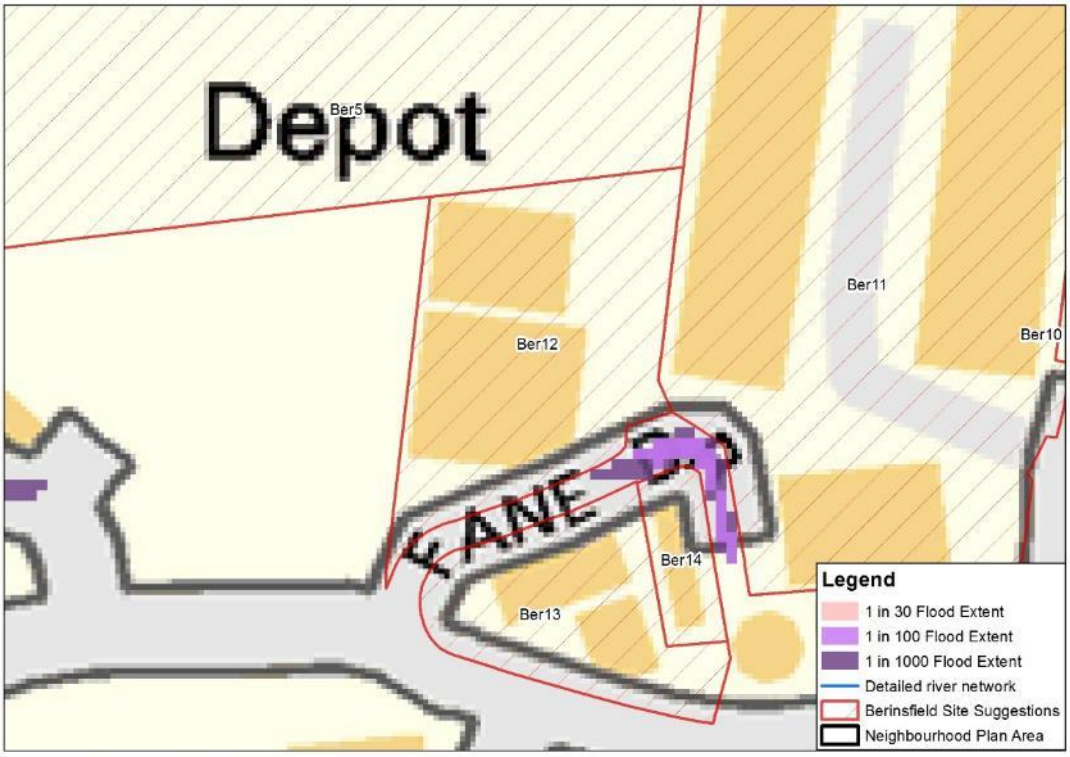
Sewer

The OX10 7 postcode has 8 properties on the Thames Water register, including 3 at risk of internal flooding, but it is not known where these properties are. No other evidence found of sewer flooding.

Surface water

The uFMfSW shows the site to be at very low risk from surface water flooding.

Updated Flood Map for Surface Water



Effects of climate change

Flood risk is not expected to increase noticeably.

Implications for development

- Does not require a full FRA for a site <1ha in Flood Zone 1 (as long as there is not a known drainage issue).
- Development should aim to reduce runoff rates from the site compared with the previous usage through development layout and use of appropriate SuDS.

A.2.13 Ber13

Site Name: Ber13

Area: 0.15 ha | **Brownfield/greenfield:** Brownfield

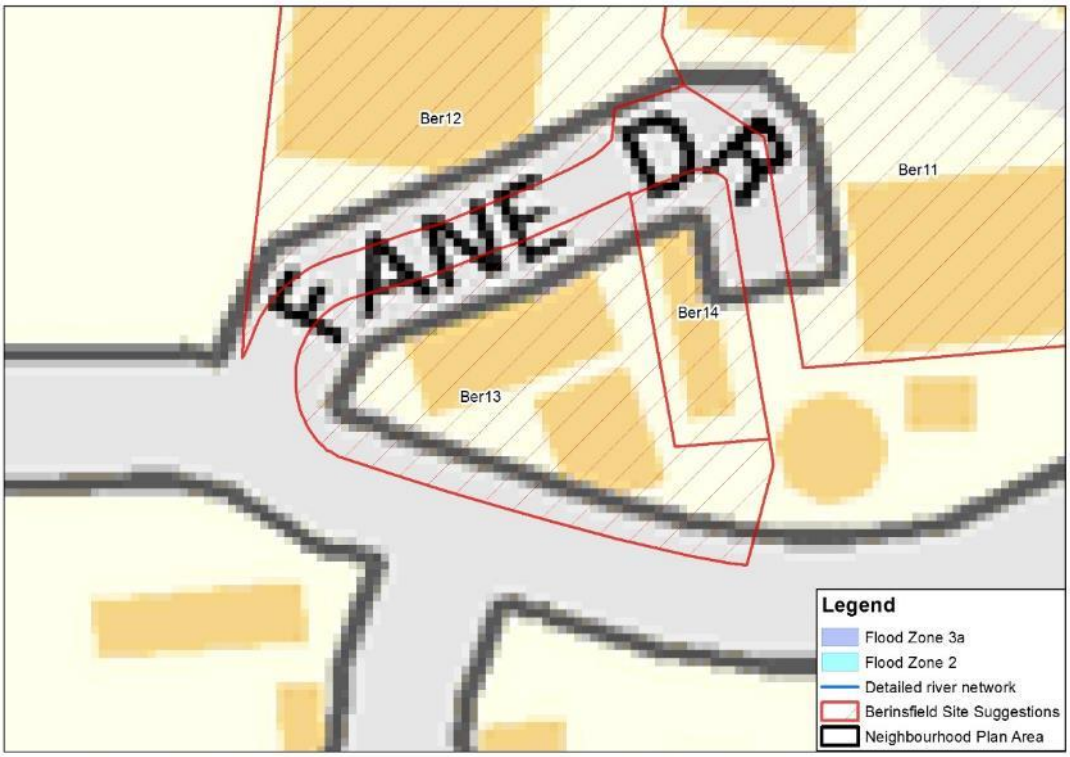
Summary of flood risk to site

Fluvial

There is no known risk from fluvial flooding.

There are no formal flood defences.

Flood Zone map



Available survey/detailed modelling

No detailed model available.

Groundwater

The AStGWF map shows the site is at medium risk of groundwater emergence.

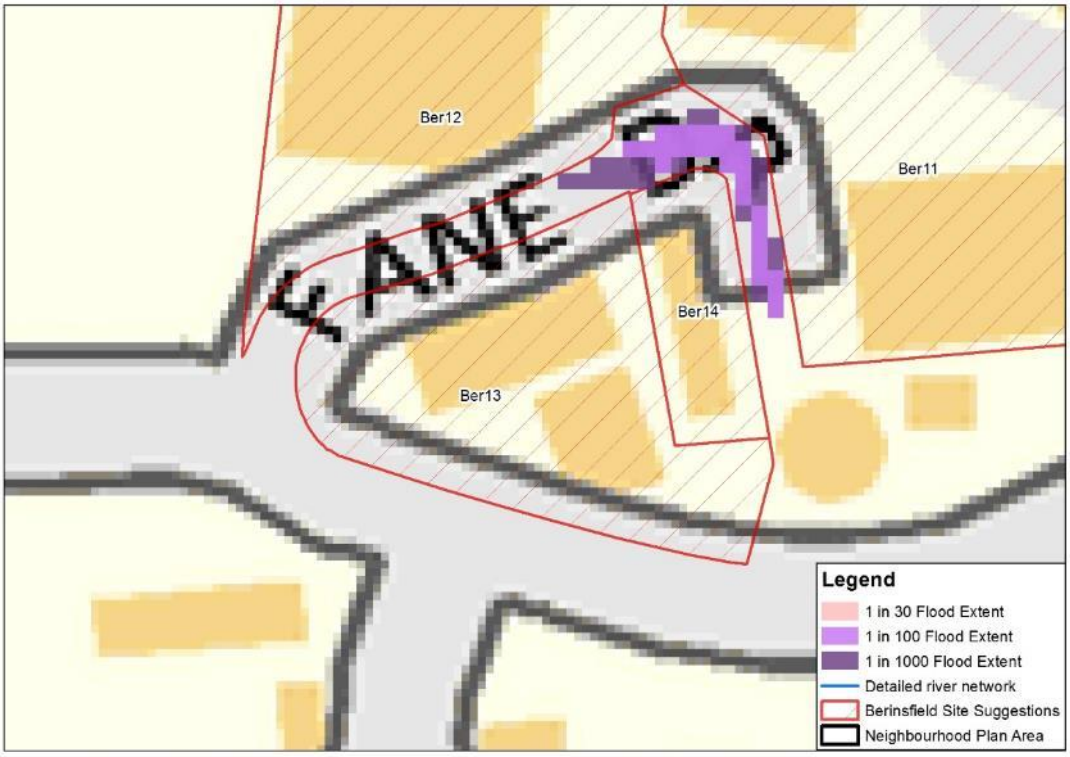
Sewer

The OX10 7 postcode has 8 properties on the Thames Water register, including 3 at risk of internal flooding, but it is not known where these properties are. No other evidence found of sewer flooding.

Surface water

The uFMfSW shows the site to be at very low risk from surface water flooding.

Updated Flood Map for Surface Water



Effects of climate change

Flood risk is not expected to increase noticeably.

Implications for development

- Does not require a full FRA for a site <1ha in Flood Zone 1 (as long as there is not a known drainage issue).
- Development should aim to reduce runoff rates from the site compared with the previous usage through development layout and use of appropriate SuDS.

A.2.14 Ber14

Site Name: Ber14

Area: 0.04 ha | **Brownfield/greenfield:** Brownfield

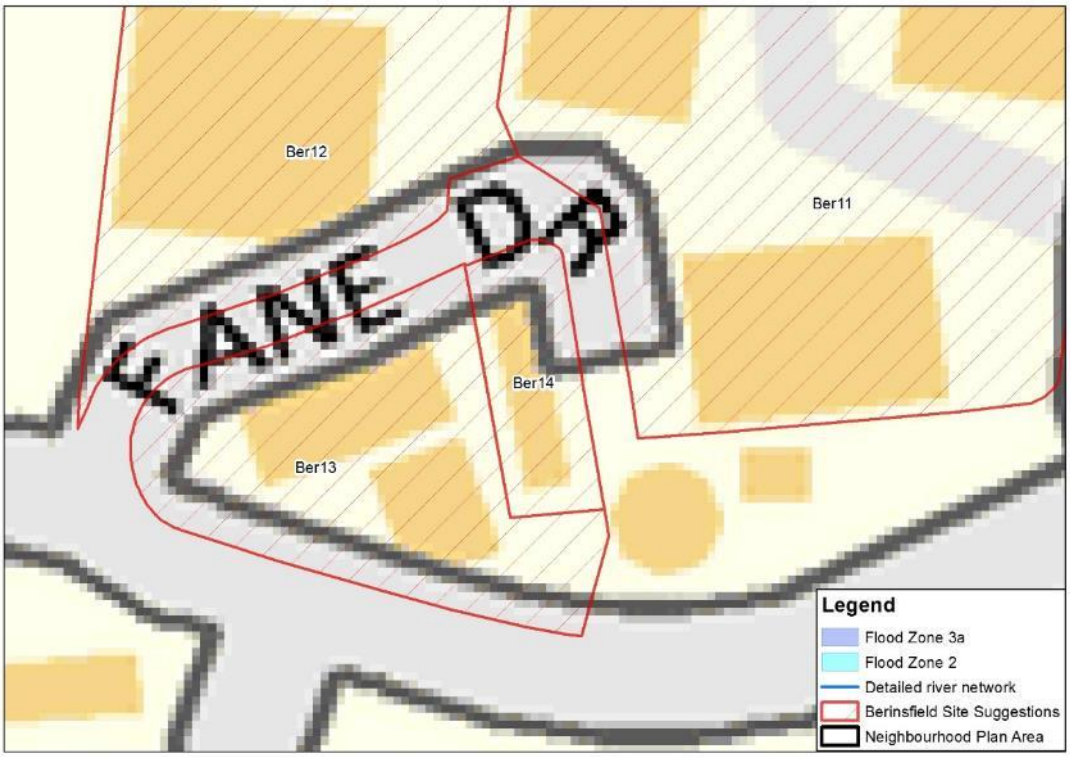
Summary of flood risk to site

Fluvial

There is no known risk from fluvial flooding.

There are no formal flood defences.

Flood Zone map



Available survey/detailed modelling

No detailed model available.

Groundwater

The AStGWF map shows the site is at medium risk of groundwater emergence.

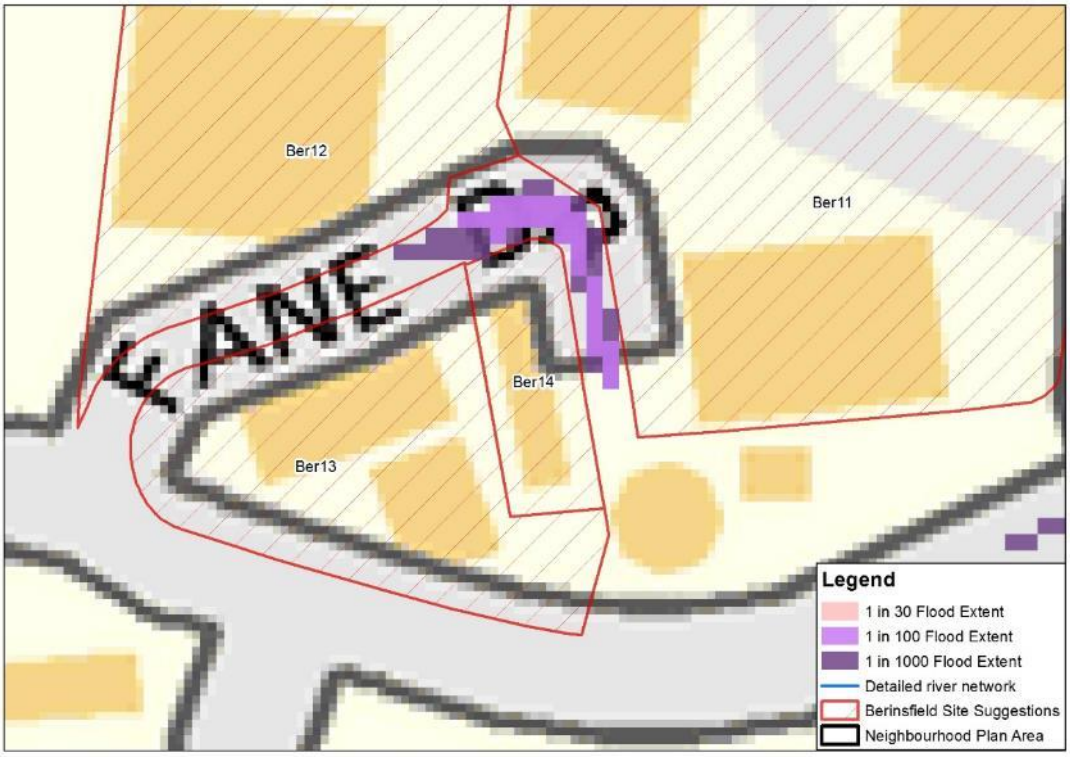
Sewer

The OX10 7 postcode has 8 properties on the Thames Water register, including 3 at risk of internal flooding, but it is not known where these properties are. No other evidence found of sewer flooding.

Surface water

The uFMfSW shows the site to be at very low risk from surface water flooding, although the access to the site, Fane Drive, is shown to be at medium risk of ponding.

Updated Flood Map for Surface Water



Effects of climate change

Increased rainfall intensity in the future may exacerbate any surface water flooding problems.

Implications for development

- Does not require a full FRA for a site <1ha in Flood Zone 1 (as long as there is not a known drainage issue).
- Development should aim to reduce runoff rates from the site compared with the previous usage through development layout and use of appropriate SuDS.

A.2.15 Ber15

Site Name: Ber15

Area: 0.12 ha | **Brownfield/greenfield:** Brownfield

Summary of flood risk to site

Fluvial

There is no known risk from fluvial flooding.

There are no formal flood defences.

Flood Zone map

Available survey/detailed modelling

No detailed model available.

Groundwater

The AStGWF map shows the site is at medium risk of groundwater emergence.

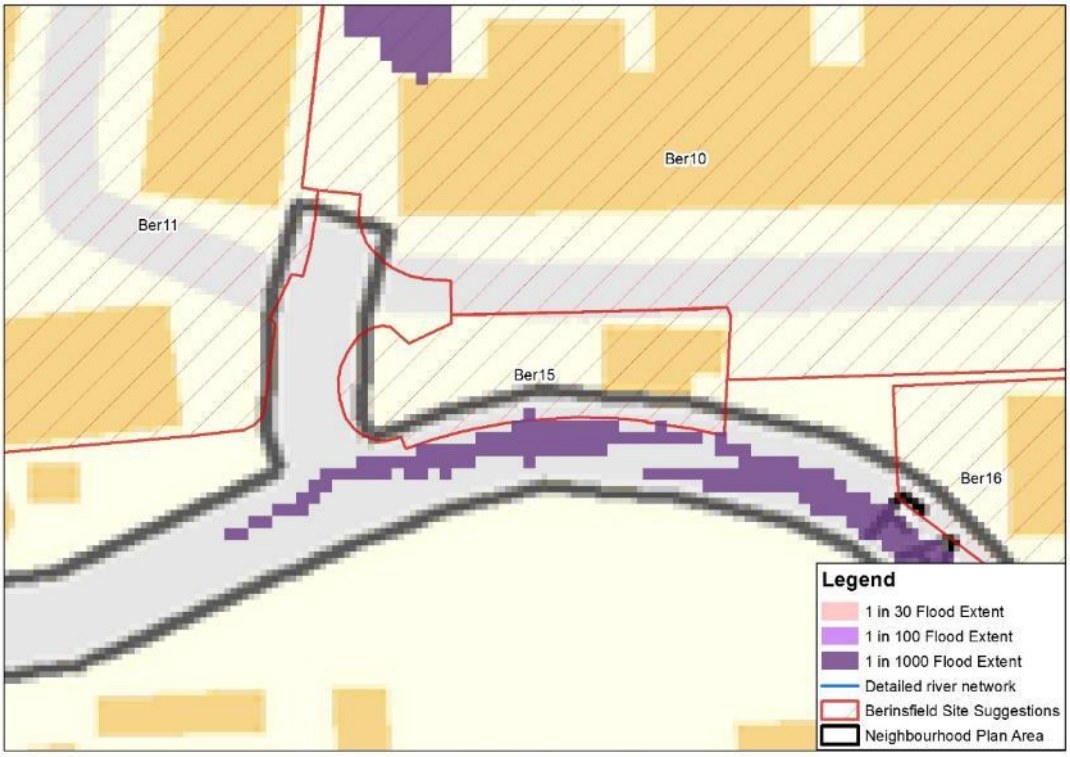
Sewer

The OX10 7 postcode has 8 properties on the Thames Water register, including 3 at risk of internal flooding, but it is not known where these properties are. No other evidence found of sewer flooding.

Surface water

The uFMfSW shows the site to be at very low risk from surface water flooding.

Updated Flood Map for Surface Water



Effects of climate change

Flood risk is not expected to increase noticeably.

Implications for development

- Does not require a full FRA for a site <1ha in Flood Zone 1 (as long as there is not a known drainage issue).
- Development should aim to reduce runoff rates from the site compared with the previous usage through development layout and use of appropriate SuDS.

A.2.16 Ber16

Site Name: Ber16

Area: 0.22 ha | **Brownfield/greenfield:** Mixed

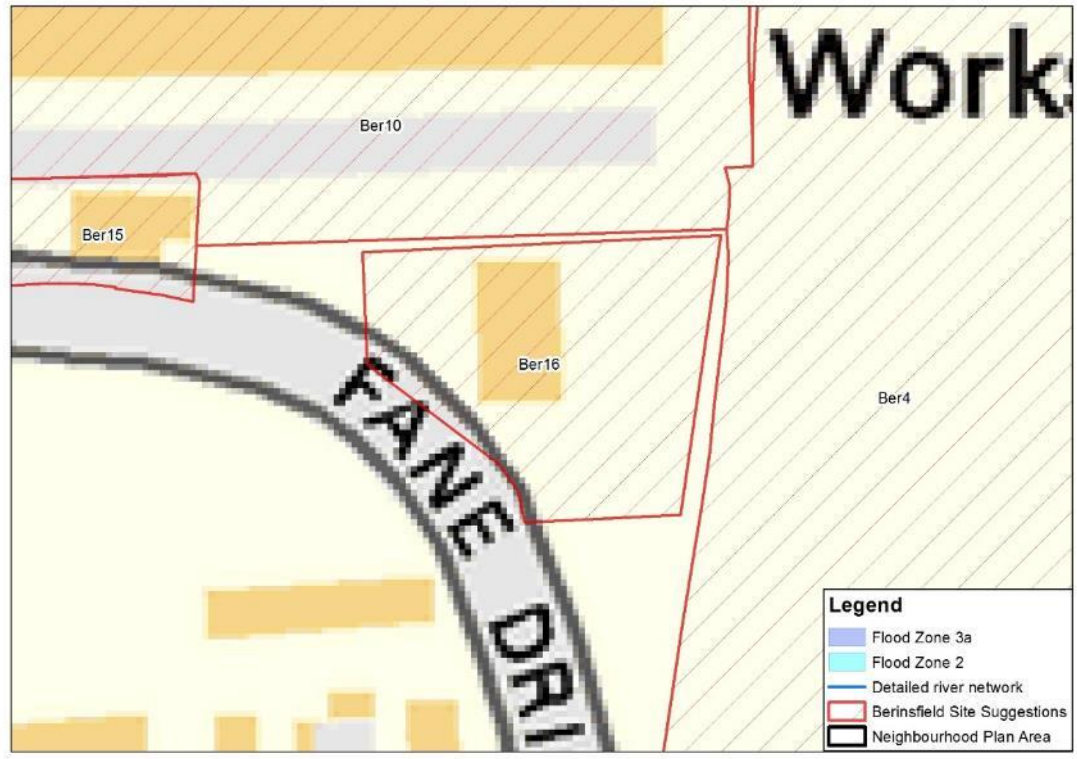
Summary of flood risk to site

Fluvial

There is no known risk from fluvial flooding.

There are no formal flood defences.

Flood Zone map



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Available survey/detailed modelling

No detailed model available.

Groundwater

The AStGWF map shows the site is at medium risk of groundwater emergence.

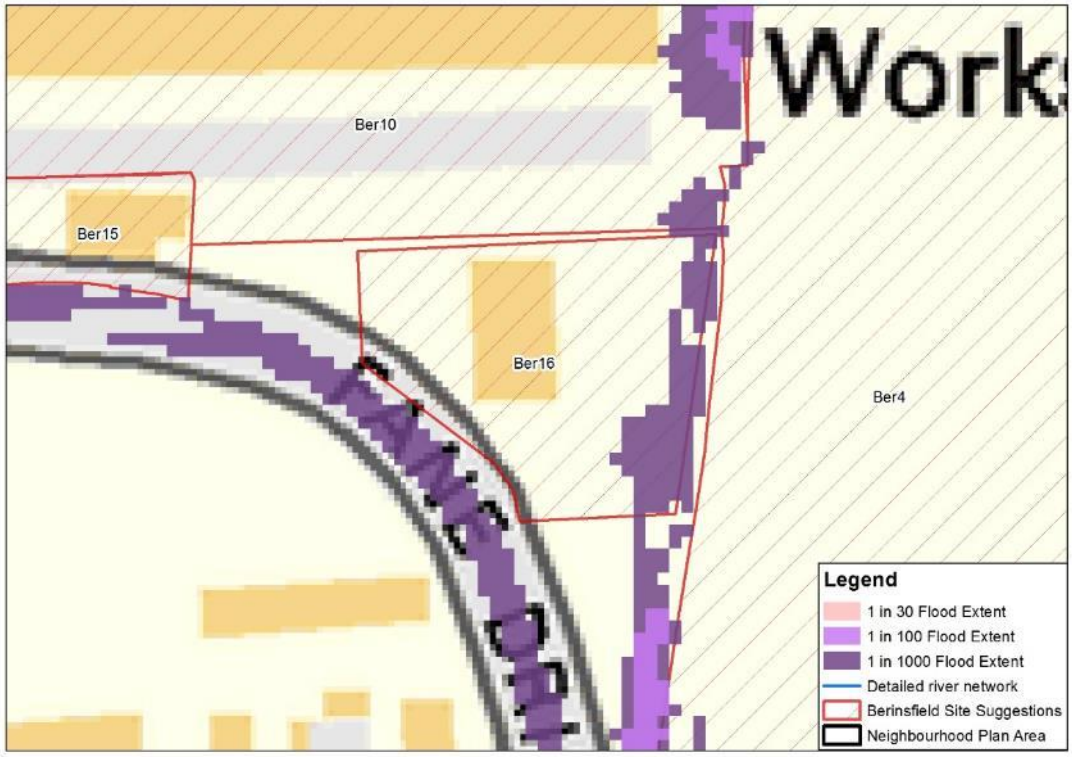
Sewer

The OX10 7 postcode has 8 properties on the Thames Water register, including 3 at risk of internal flooding, but it is not known where these properties are. No other evidence found of sewer flooding.

Surface water

The uFMfSW shows areas at medium risk of potential ponding in the east of the site.

Updated Flood Map for Surface Water



Effects of climate change

Increased rainfall intensity in the future may exacerbate any surface water flooding problems.

Implications for development

- Does not require a full FRA for a site <1ha in Flood Zone 1 (as long as there is not a known drainage issue).
- Development should aim to reduce runoff rates from the site compared with the previous usage through development layout and use of appropriate SuDS.

A.2.17 Ber17

Site Name: Ber17

Area: 1.49 ha | **Brownfield/greenfield:** Brownfield

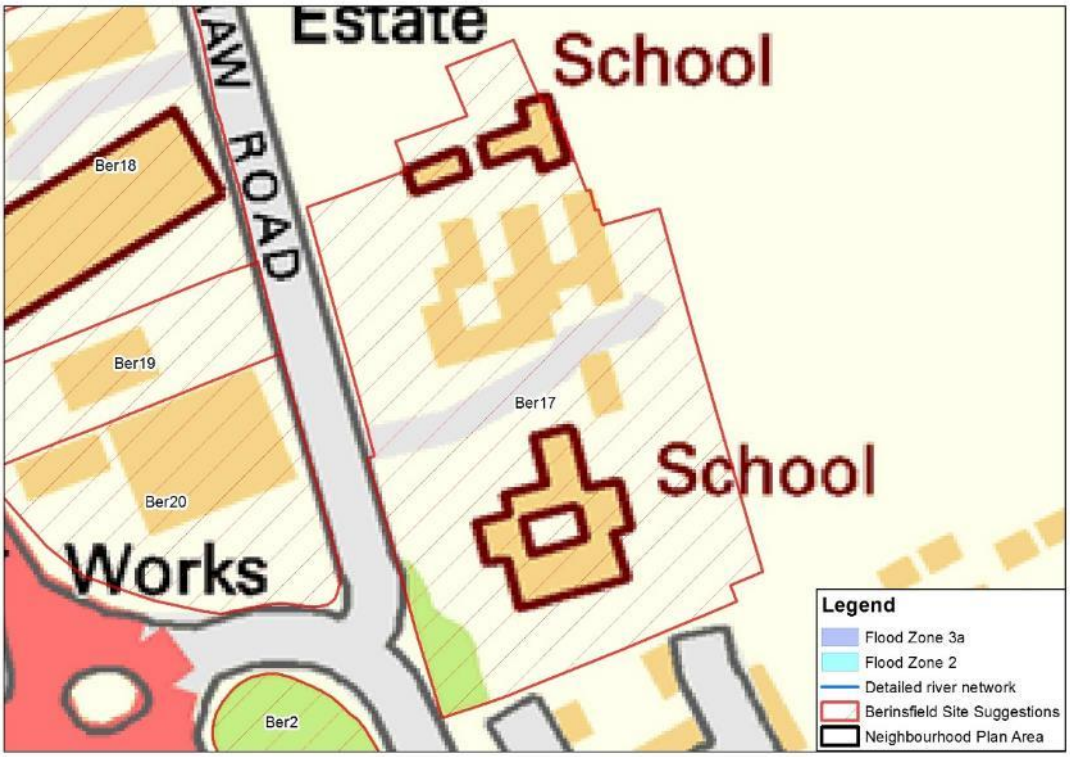
Summary of flood risk to site

Fluvial

There is no known risk from fluvial flooding.

There are no formal flood defences.

Flood Zone map



Available survey/detailed modelling

No detailed model available.

Groundwater

The AStGWF map suggests the northern half of the site to be at a medium risk from groundwater emergence, increasing to the highest category to the south, closer to the River Thames alluvial gravels.

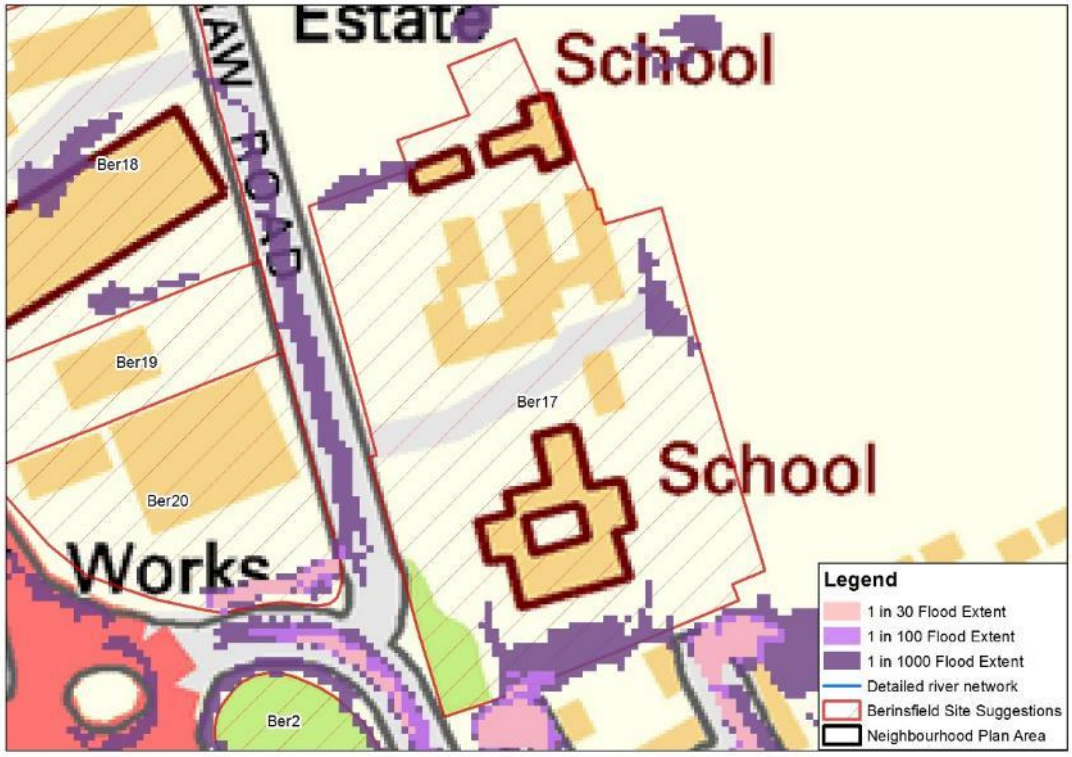
Sewer

The OX10 7 postcode has 8 properties on the Thames Water register, including 3 at risk of internal flooding, but it is not known where these properties are. No other evidence found of sewer flooding.

Surface water

The uFMfSW shows discrete areas of potential ponding, the largest and highest risk in the south of the site.

Updated Flood Map for Surface Water



Effects of climate change

Increased rainfall intensity in the future may exacerbate any surface water flooding problems. Wetter winters may increase groundwater flood risk.

Implications for development

- Requires a full FRA for a site >1ha in Flood Zone 1.
- The FRA should demonstrate the site has been designed to mitigate any surface water risk.
- FRA should include a detailed assessment of groundwater flood risk.
- The FRA should aim to reduce runoff rates from the site compared with the previous usage through development layout and use of appropriate SuDS.

A.2.18 Ber18

Site Name: Ber18	
Area: 1.08 ha	**Brownfield/greenfield:** Brownfield

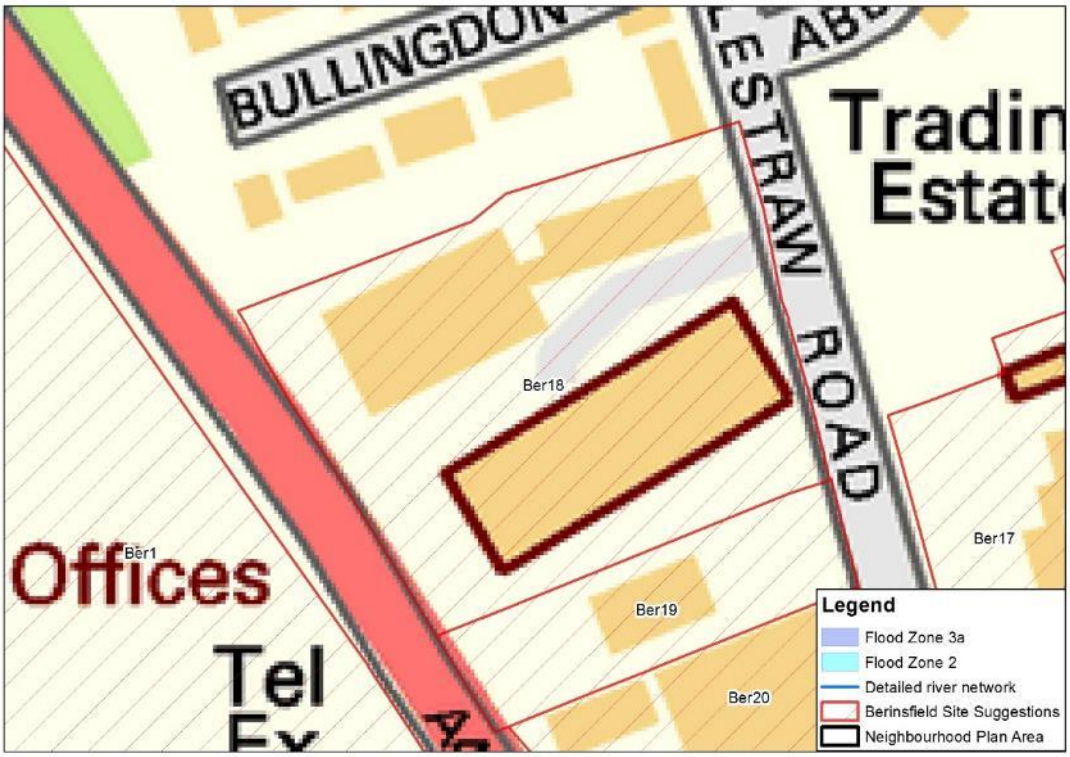
Summary of flood risk to site

Fluvial

There is no known risk from fluvial flooding.

There are no formal flood defences.

Flood Zone map



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Available survey/detailed modelling

No detailed model available.

Groundwater

The AStGWF map shows the site is at medium risk of groundwater emergence.

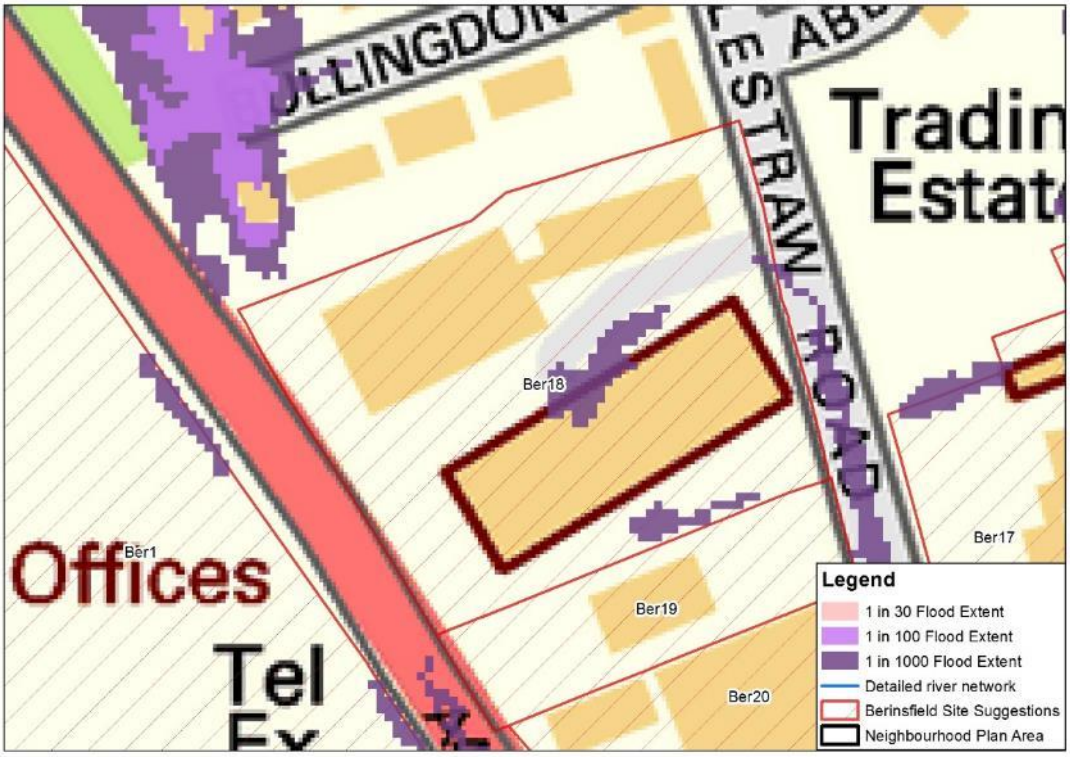
Sewer

The OX10 7 postcode has 8 properties on the Thames Water register, including 3 at risk of internal flooding, but it is not known where these properties are. No other evidence found of sewer flooding.

Surface water

The uFMfSW shows some small areas at low risk of potential ponding.

Updated Flood Map for Surface Water



Effects of climate change

Increased rainfall intensity in the future may exacerbate any surface water flooding problems.

Implications for development

- Requires a full FRA for a site >1ha in Flood Zone 1.
- The FRA should demonstrate the site has been designed to mitigate any surface water risk.
- FRA should include a detailed assessment of groundwater flood risk.
- The FRA should aim to reduce runoff rates from the site compared with the previous usage through development layout and use of appropriate SuDS.

A.2.19 Ber19

Site Name: Ber19	
Area: 0.27 ha	**Brownfield/greenfield:** Mixed

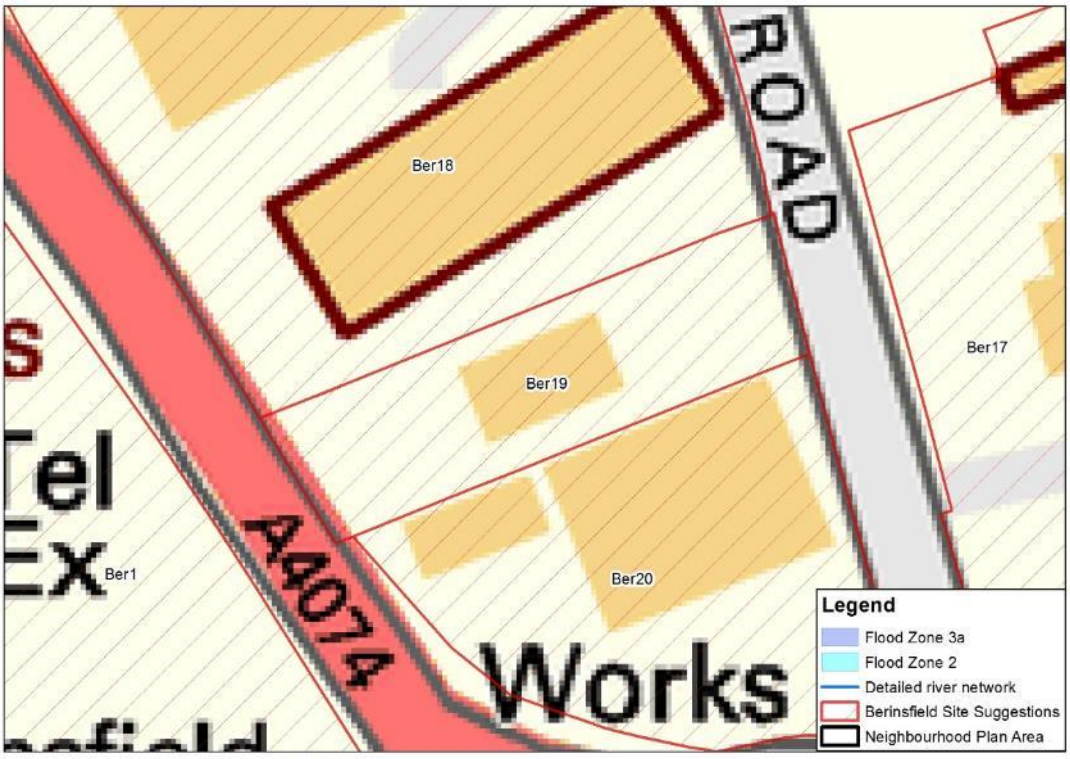
Summary of flood risk to site

Fluvial

There is no known risk from fluvial flooding.

There are no formal flood defences.

Flood Zone map



Available survey/detailed modelling

No detailed model available.

Groundwater

The AStGWF map shows the site to be predominantly at medium risk from groundwater emergence with the southern tip increasing to the highest category.

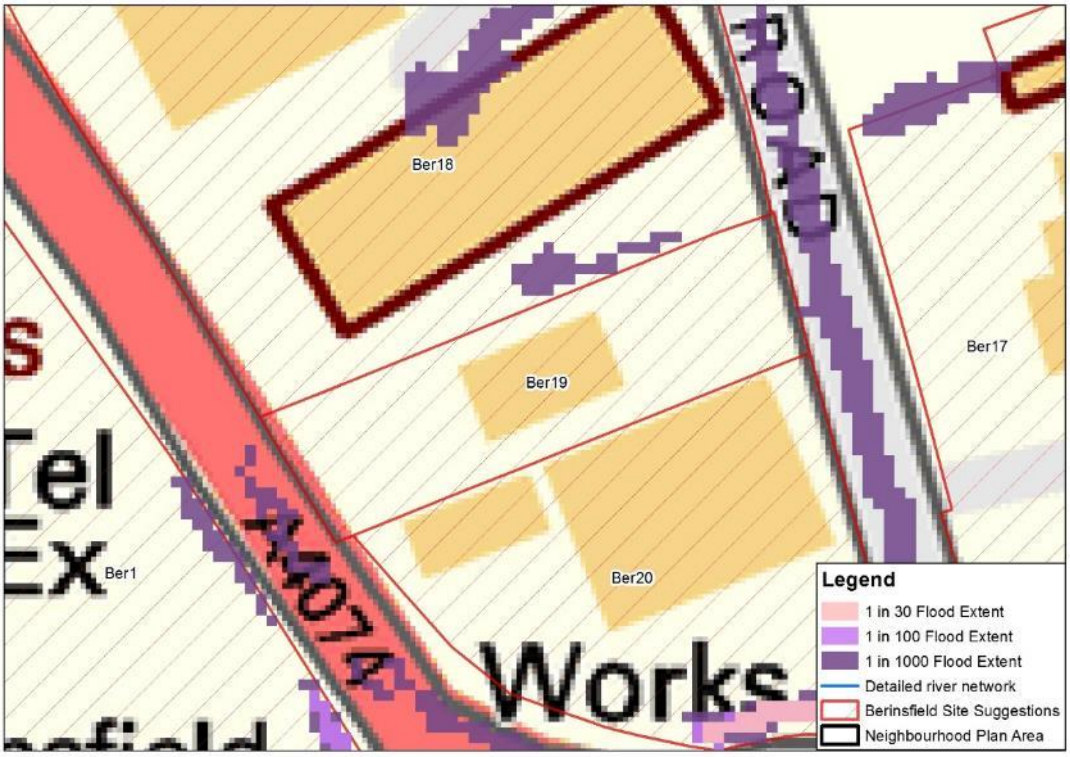
Sewer

The OX10 7 postcode has 8 properties on the Thames Water register, including 3 at risk of internal flooding, but it is not known where these properties are. No other evidence found of sewer flooding.

Surface water

The uFMfSW shows the site to be at very low risk from surface water flooding.

Updated Flood Map for Surface Water



Effects of climate change

Increased rainfall intensity in the future may exacerbate any surface water flooding problems. Wetter winters may increase groundwater flood risk.

Implications for development

- Does not require a full FRA for a site <1ha in Flood Zone 1 (as long as there is not a known drainage issue).
- Development should aim to reduce runoff rates from the site compared with the previous usage through development layout and use of appropriate SuDS.

A.2.20 Ber20

Site Name: Ber20

Area: 0.47 ha | **Brownfield/greenfield:** Brownfield

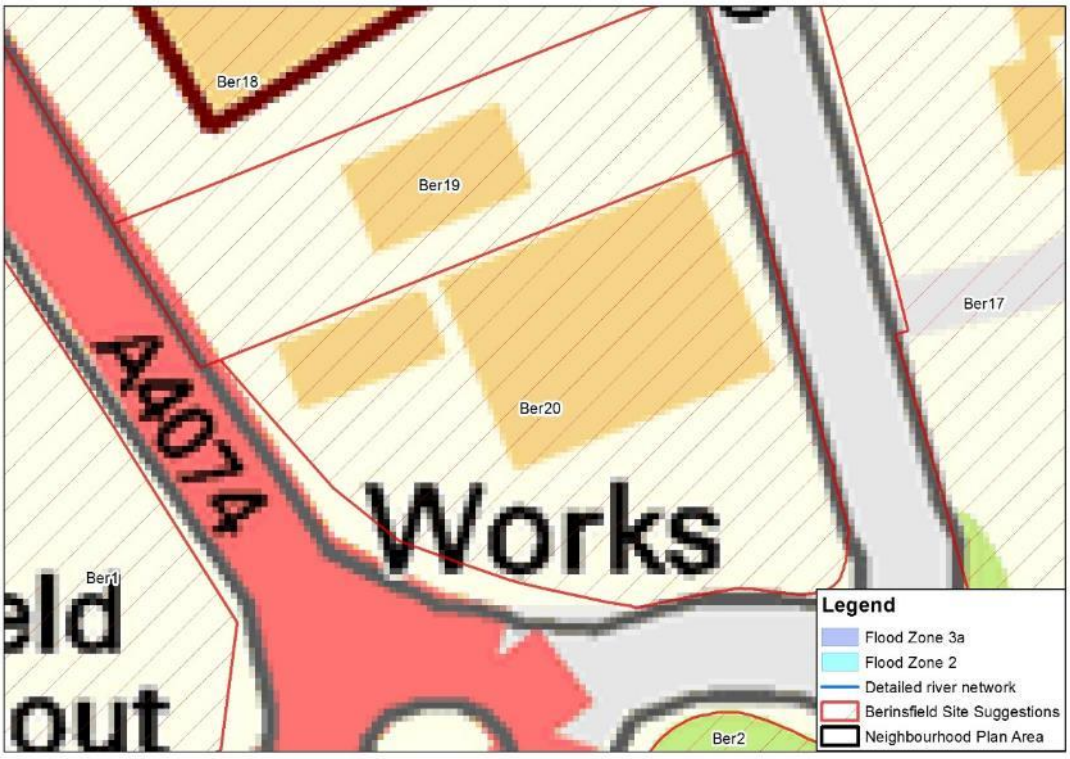
Summary of flood risk to site

Fluvial

There is no known risk from fluvial flooding.

There are no formal flood defences.

Flood Zone map



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Available survey/detailed modelling

No detailed model available.

Groundwater

The AStGWF map shows the site to be predominantly within the highest risk category from groundwater emergence with the northern tip at medium risk.

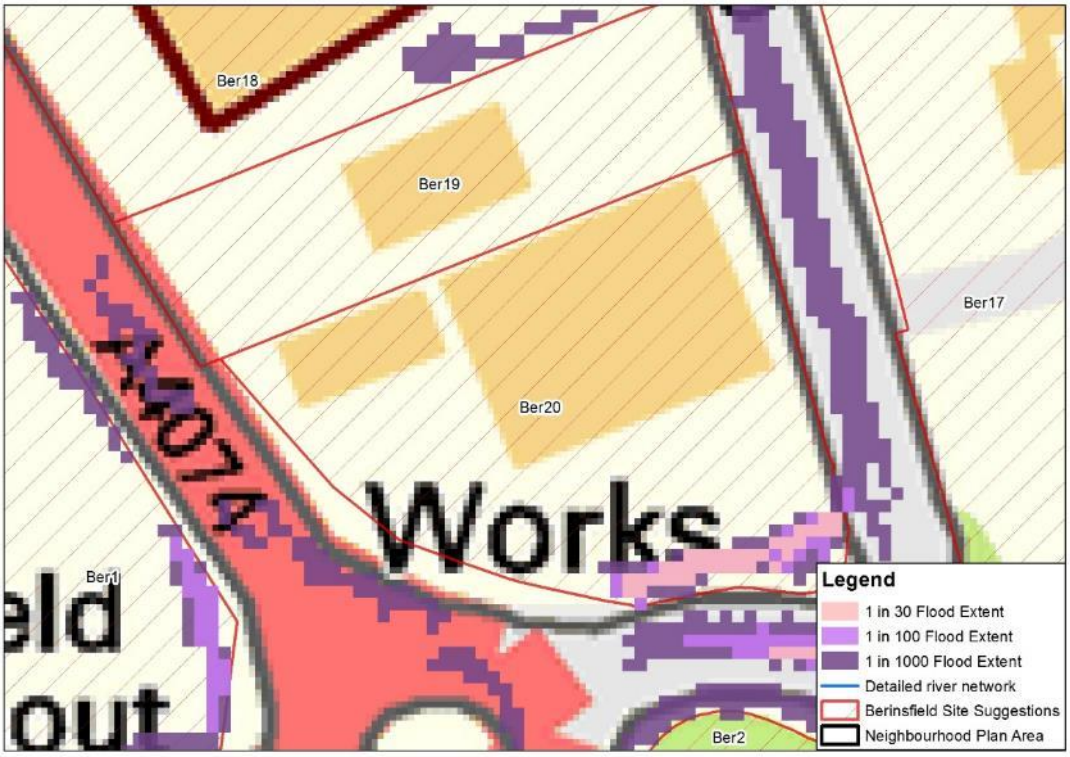
Sewer

The OX10 7 postcode has 8 properties on the Thames Water register, including 3 at risk of internal flooding, but it is not known where these properties are. No other evidence found of sewer flooding.

Surface water

The uFMfSW shows the site to have a high potential of ponding near to the Berinsfield roundabout.

Updated Flood Map for Surface Water



Effects of climate change

Increased rainfall intensity in the future may exacerbate any surface water flooding problems. Wetter winters may increase groundwater flood risk.

Implications for development

- Does not require a full FRA for a site <1ha in Flood Zone 1 (as long as there is not a known drainage issue).
- The site should be designed to mitigate any surface water risk.
- Development should aim to reduce runoff rates from the site compared with the previous usage through development layout and use of appropriate SuDS.

A.2.21 Ber21

Site Name: Ber21

Area: 1.37 ha	**Brownfield/greenfield:** Brownfield

Summary of flood risk to site

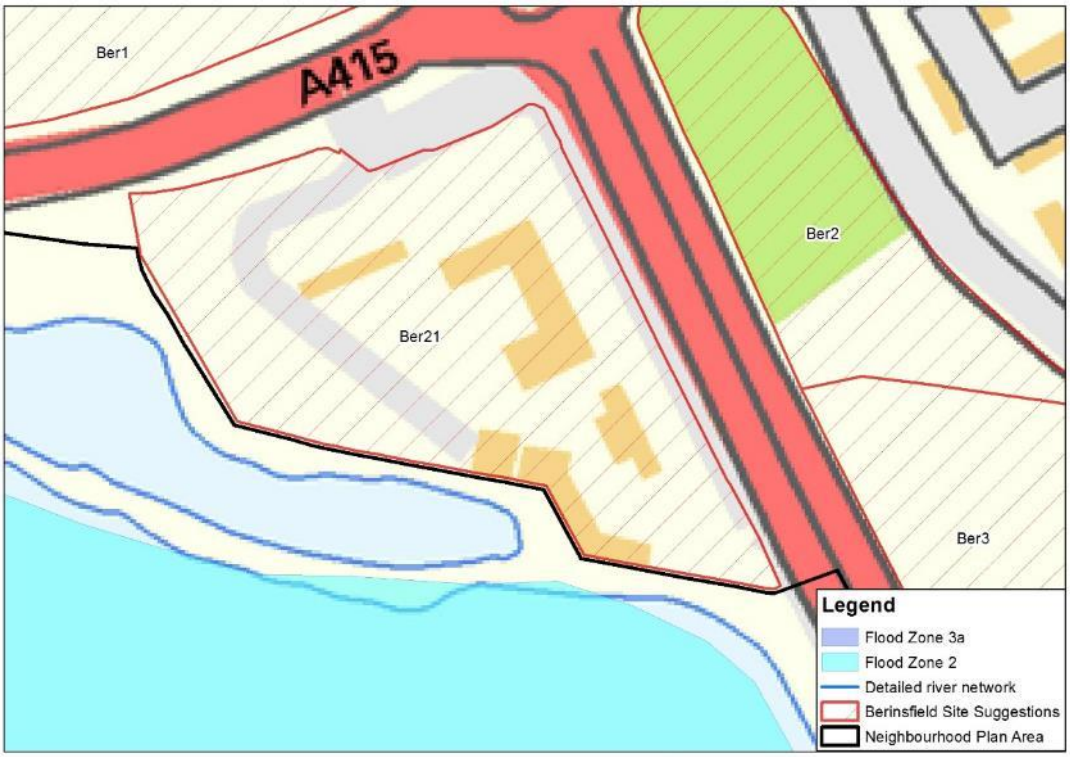
Fluvial

There is no known risk from fluvial flooding.

The modelled flood level from the River Thames model at this location is 48.39mAOD for the 1 in 1000 year event. The site is approximately 1m above this level.

There are no formal flood defences.

Flood Zone map



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Available survey/detailed modelling

The following detailed model has been used within the Flood Map:

River Thames Sandford to Whitchurch (Environment Agency, 2000) hydraulic model

Groundwater

The AStGWF map shows the site to be within the highest category of groundwater emergence due to its proximity to the River Thames alluvial gravels.

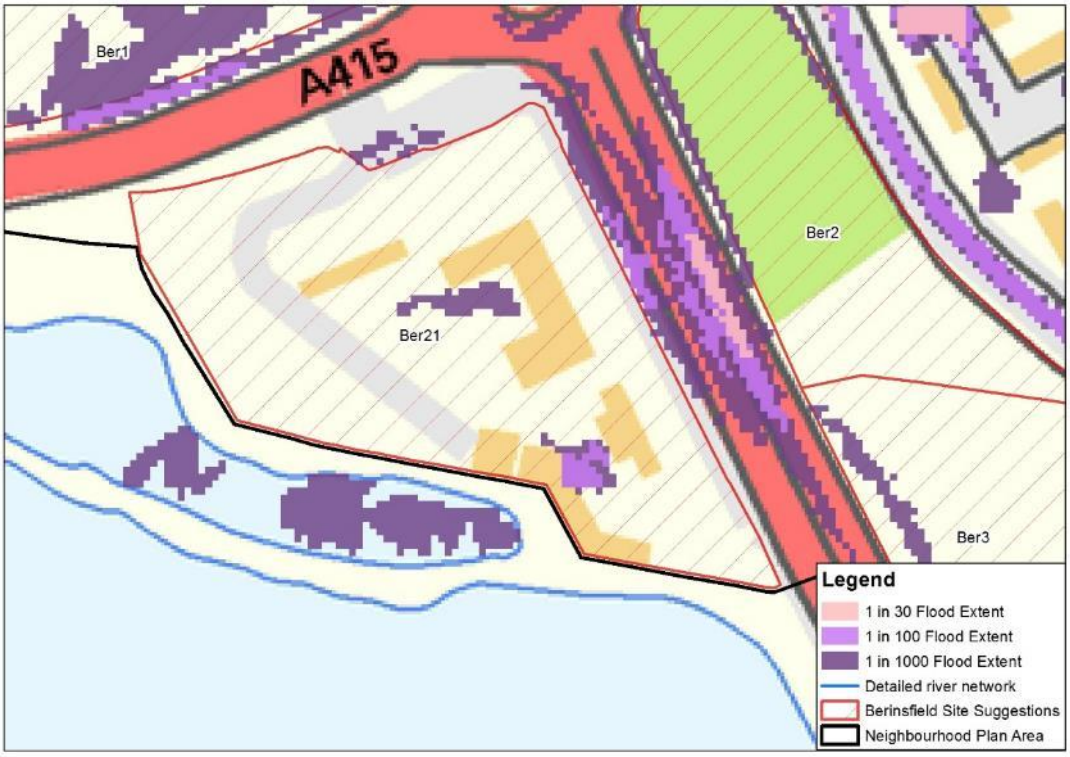
Sewer

The OX10 7 postcode has 8 properties on the Thames Water register, including 3 at risk of internal flooding, but it is not known where these properties are. No other evidence found of sewer flooding.

Surface water

The uFMfSW shows discrete locations of low and medium risk potential ponding.

Updated Flood Map for Surface Water



Effects of climate change

Increased rainfall intensity in the future may exacerbate any surface water flooding problems. Wetter winters may increase groundwater flood risk.

Implications for development

- Requires a full FRA for a site >1ha in Flood Zone 1.
- FRA should include a detailed assessment of groundwater flood risk.
- A drainage strategy should be submitted at an early stage to cover mitigation of any surface water risk.
- The FRA should aim to reduce runoff rates from the site compared with the previous usage through development layout and use of appropriate SuDS.

A.2.22 Ber22

Site Name: Ber22

Area: 1.36 ha	**Brownfield/greenfield:** Greenfield

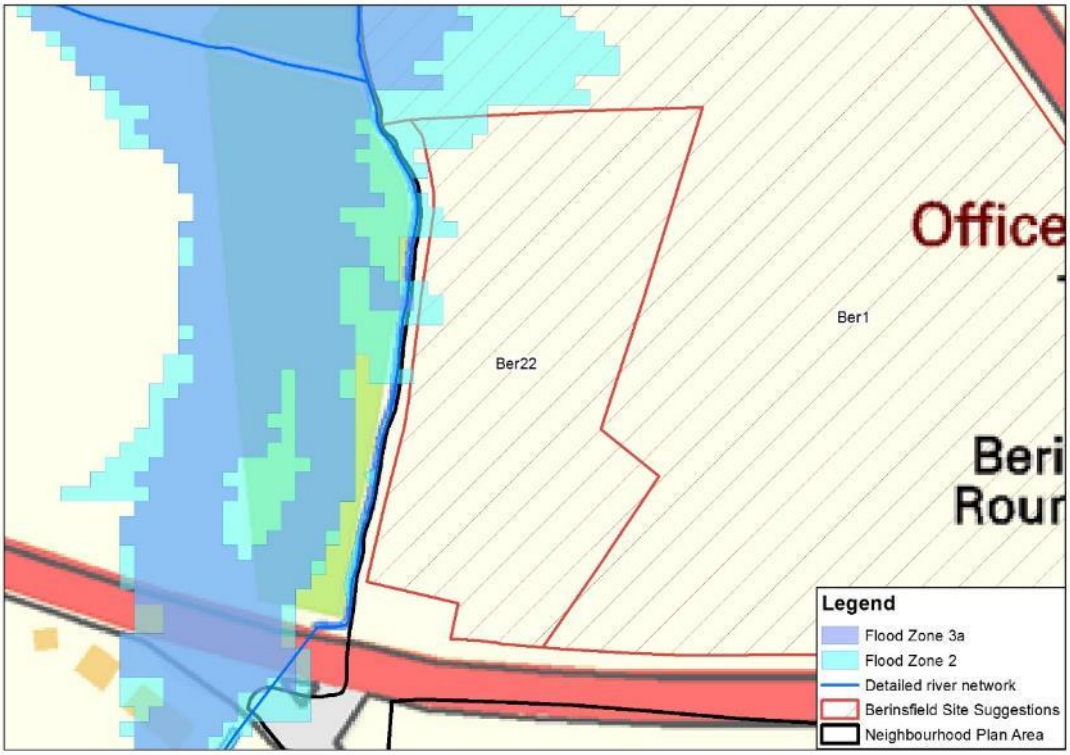
Summary of flood risk to site

Fluvial

Burcot Brook flows from north to south along the west boundary of the site. Flood Zone 2 and 3 are directly adjacent to the western edge of the site with Flood Zone 2 covering small regions of the site.

There are no formal flood defences.

Flood Zone map



Available survey/detailed modelling

No detailed model available. Burcot Brook broad-scale mapping.

Groundwater

The AStGWF map suggests the northern half of the site to be at a medium risk from groundwater emergence, increasing to the highest category to the south, closer to the River Thames alluvial gravels.

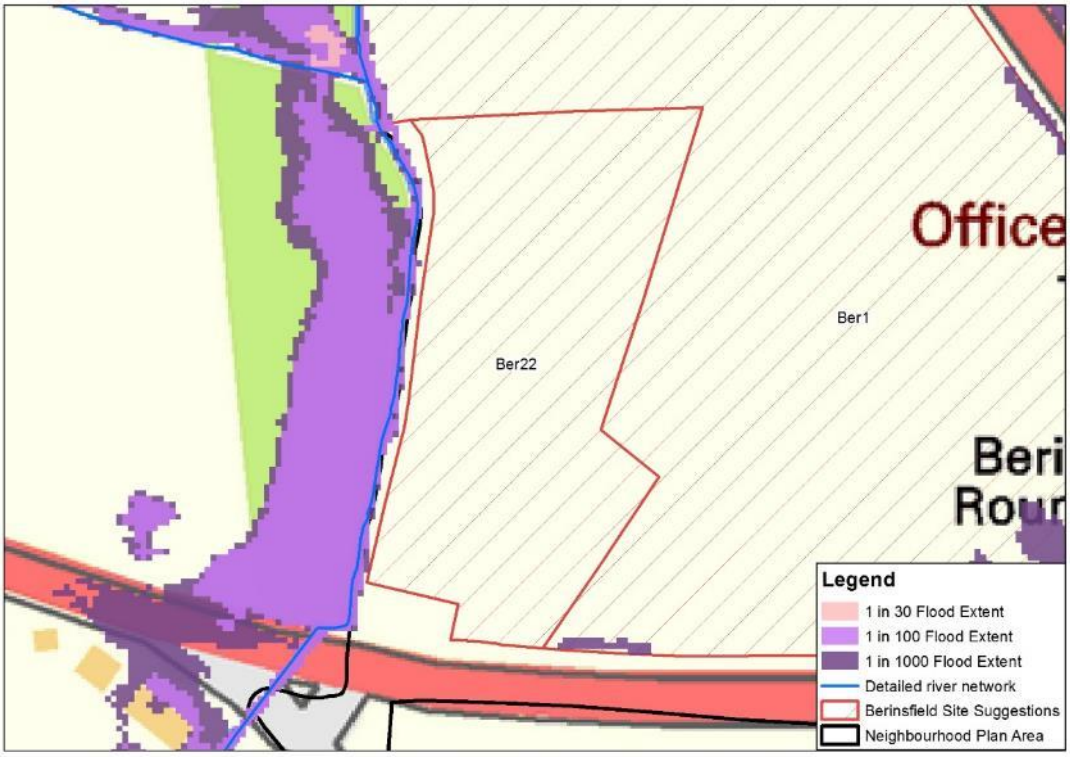
Sewer

No known problems (site is greenfield).

Surface water

The uFMfSW shows the site to be at very low risk from surface water flooding, however there is a flow path adjacent to the western boundary of the site associated with the Burcot Brook.

Updated Flood Map for Surface Water



Effects of climate change

Climate change is likely to increase the fluvial flood extent such that the north and eastern boundaries of the site will be adjacent to the 1 in 100 year flood zone.

Increased rainfall intensity in the future may exacerbate any surface water flooding problems.

Wetter winters may increase groundwater flood risk.

Implications for development

- Requires a full FRA for a site in Flood Zone 2.
- The FRA should demonstrate that the development will not be at risk from fluvial or surface water flooding from Burcot Brook.
- FRA should include a detailed assessment of groundwater flood risk.
- It must be demonstrated that the site will be designed sequentially ensuring all development will be outside of Flood Zone 2 with climate change.
- Opportunities for enhancing the amenity value of the area adjacent to the Flood Zones.
- It must be demonstrated that safe, dry access and egress will be available during a severe flood event.
- The development must not increase existing flood risk downstream. Drainage strategy should be submitted at an early stage to cover mitigation of any surface water risk and reduce impact downstream through site design and SUDS methods. Runoff less than greenfield rates is desirable.
- Thames Water should be consulted at an early stage to ensure that there will be sufficient capacity in the wastewater system and any upgrades are carried out where necessary.

A.2.23 Ber23

Site Name: Ber23

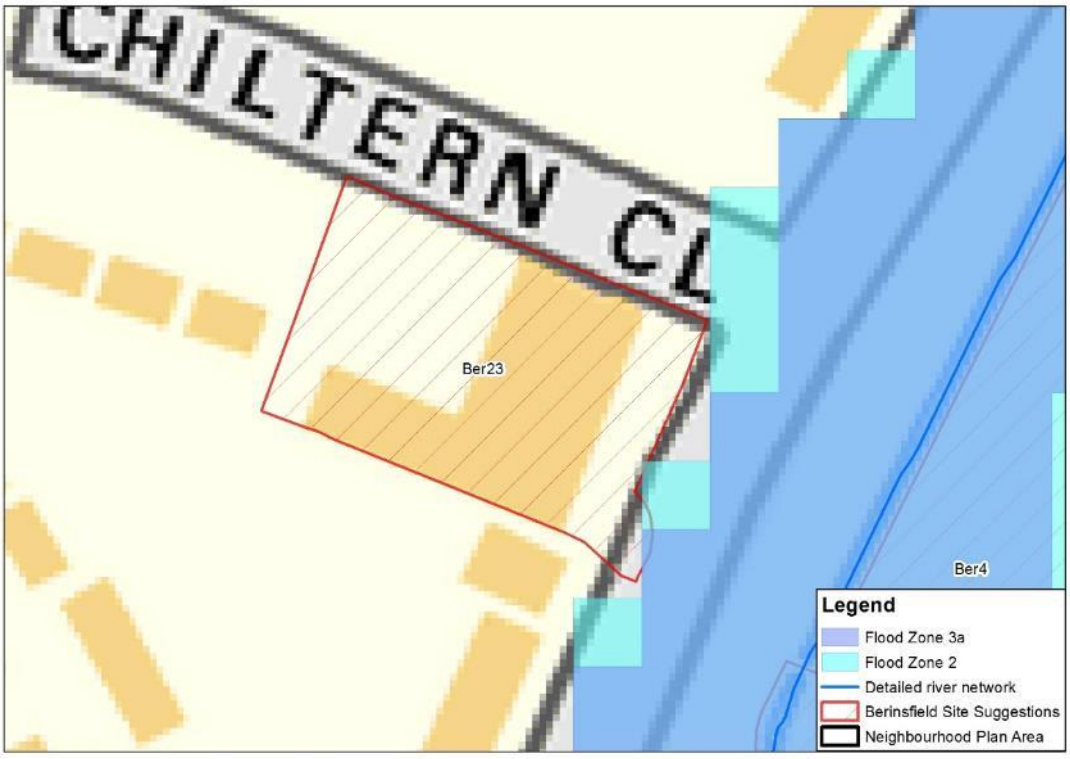
Area: 0.21 ha | **Brownfield/greenfield:** Brownfield

Summary of flood risk to site

Fluvial

Fluvial Zone 2 and 3 of Elaine's Ditch are immediately adjacent to the south east of the site. There are no formal flood defences.

Flood Zone map



Available survey/detailed modelling

No detailed model available. Elaine's Ditch broad-scale mapping.

Groundwater

The AStGWF map shows the site is at medium risk of groundwater emergence.

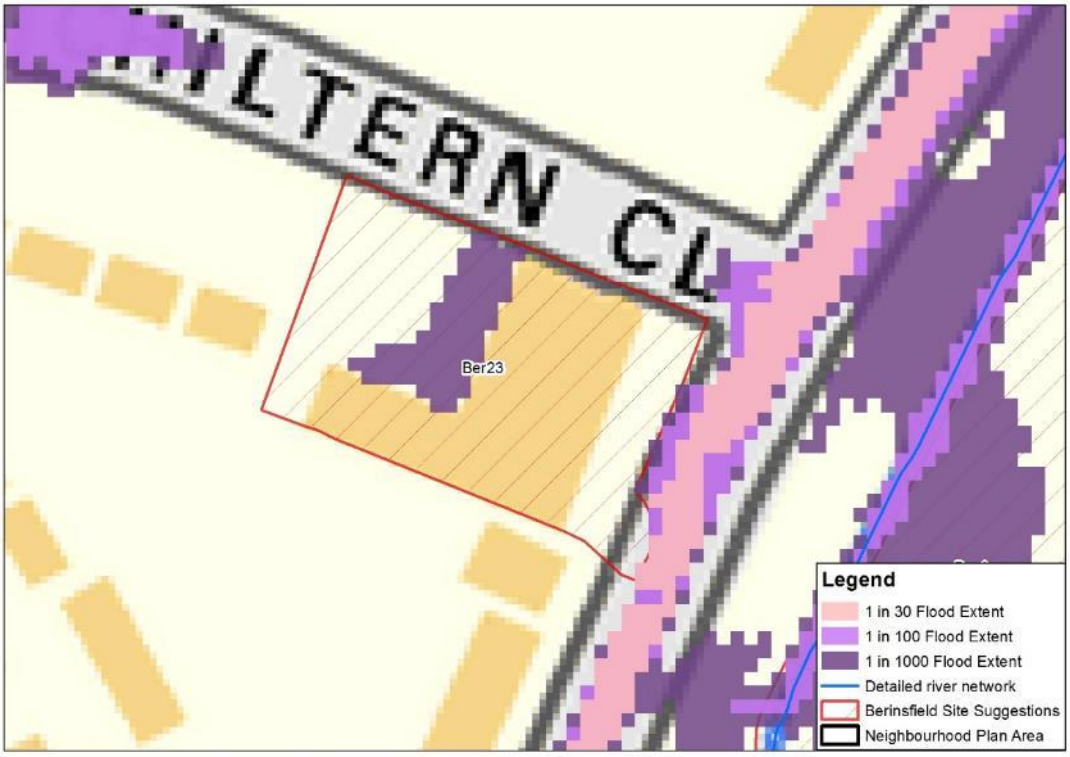
Sewer

The OX10 7 postcode has 8 properties on the Thames Water register, including 3 at risk of internal flooding, but it is not known where these properties are. No other evidence found of sewer flooding.

Surface water

The uFMfSW shows a low risk of ponding within the site. Fane Drive is at high risk from a flow path flowing from north to south.

Updated Flood Map for Surface Water



Effects of climate change

Climate change is unlikely to increase the fluvial flood extent significantly (there is little difference between the different zones).

Increased rainfall intensity in the future may exacerbate any surface water flooding problems.

Implications for development

- Does not require a full FRA for a site <1ha in Flood Zone 1 (as long as there is not a known drainage issue).
- The site should be designed to mitigate any surface water risk.
- Development should aim to reduce runoff rates from the site compared with the previous usage through development layout and use of appropriate SuDS.

A.2.24 Ber24

Site Name: Ber24

Area: 32.6 ha | **Brownfield/greenfield:** Mixed

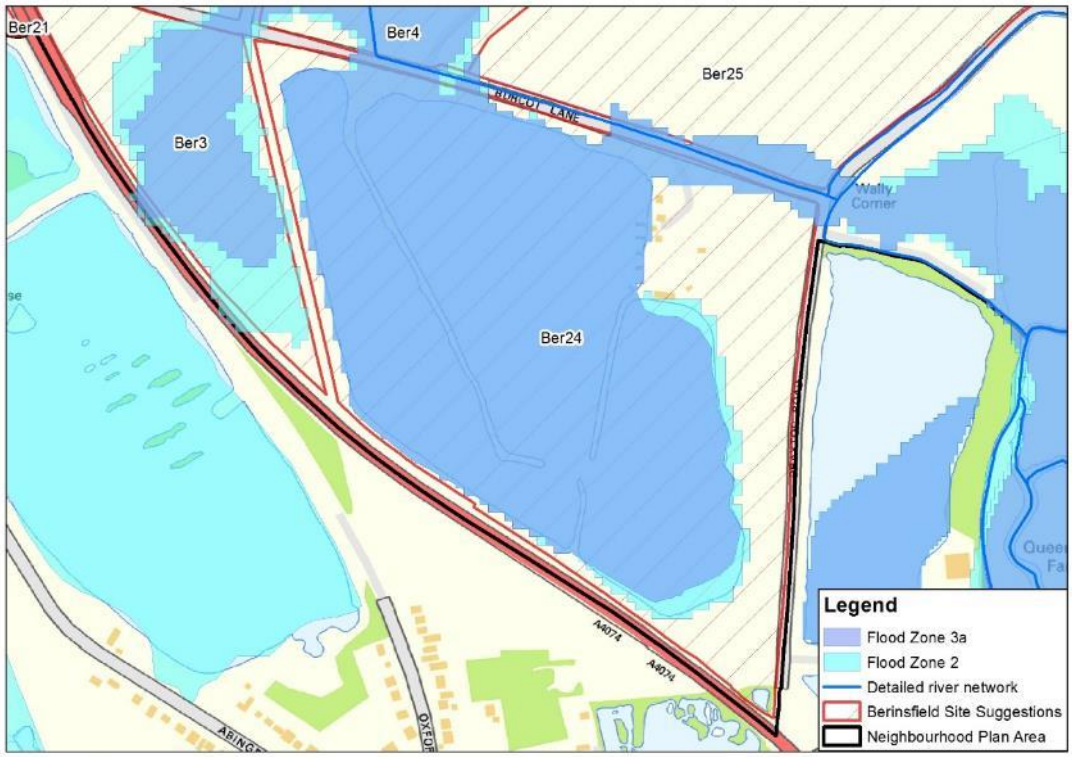
Summary of flood risk to site

Fluvial

The lakes within the site as well as part of the strip of land along the north of the site are shown to be within Flood Zones 2 and 3. The Flood Zones covering this area are based on the course-scale modelling of Elaine's Ditch which flows along Burcot Lane to the north of the site.

There are no formal flood defences.

Flood Zone map



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Available survey/detailed modelling

No detailed model available. Elaine's Ditch broad-scale mapping.

Groundwater

The AStGWF map shows the site to be within the highest category of groundwater emergence due to its proximity to the River Thames alluvial gravels.

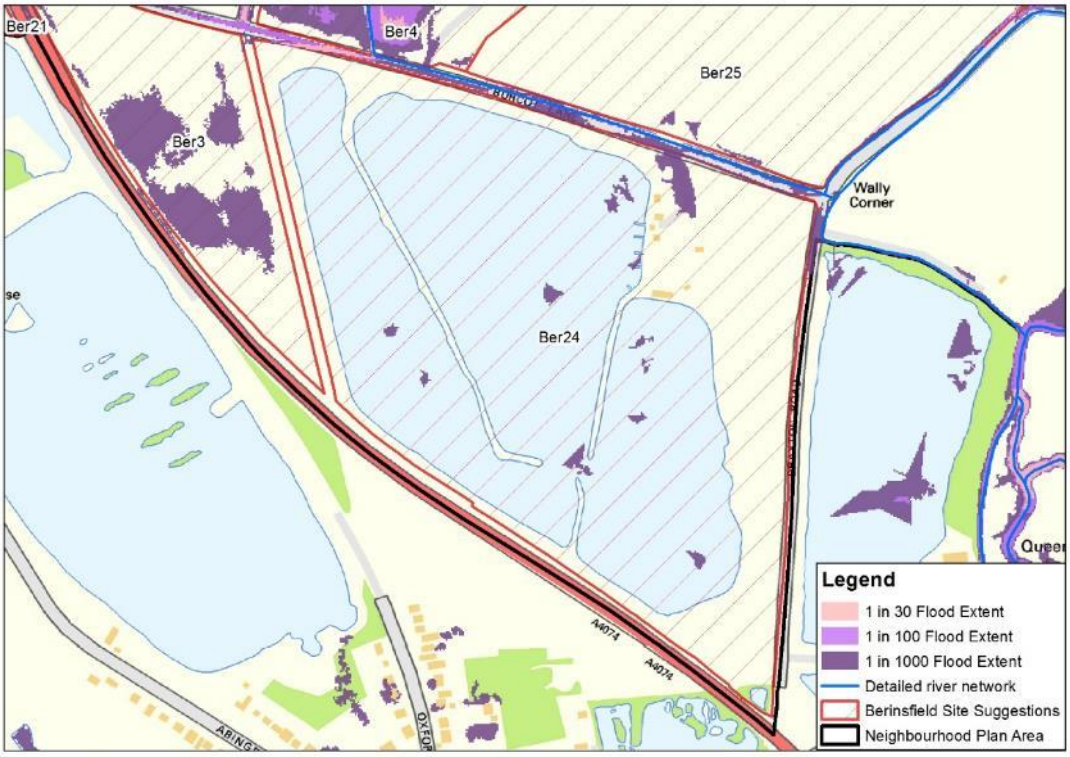
Sewer

The OX10 7 postcode has 8 properties on the Thames Water register, including 3 at risk of internal flooding, but it is not known where these properties are. No other evidence found of sewer flooding.

Surface water

The uFMfSW shows a single low risk location of ponding at the current entrance to the site.

Updated Flood Map for Surface Water



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Effects of climate change

Climate change is unlikely to increase the fluvial flood extent significantly (there is little difference between the different zones).

Increased rainfall intensity in the future may exacerbate any surface water flooding problems

Wetter winters may increase groundwater flood risk.

Implications for development

- Requires a full FRA for a site in Flood Zone 3.
- It must be demonstrated that the site will be designed sequentially ensuring all development will be outside of Flood Zone 2 with climate change.
- It must be demonstrated that safe, dry access and egress will be available during a severe flood event.
- FRA should include a detailed assessment of groundwater flood risk.
- The development must not increase existing flood risk of the surrounding area. A drainage strategy should be submitted at an early stage to cover mitigation of any surface water risk and reduce impact downstream through site design and SUDS methods. Runoff less than greenfield rates is desirable.
- Thames Water should be consulted at an early stage to ensure that there will be sufficient capacity in the wastewater system and any upgrades are carried out where necessary

A.2.25 Ber25

Site Name: Ber25

Area: 13.0 ha | **Brownfield/greenfield:** Greenfield

Summary of flood risk to site

Fluvial

Burcot Brook flows from west to east along Burcot Lane, the southern boundary of the site. Flood Zone 2 and 3 have the same extent, and cover a region in the south of the site.

There are no formal flood defences.

Flood Zone map

Available survey/detailed modelling

No detailed model available. Elaine's Ditch broad-scale mapping.

Groundwater

The AStGWF map shows the site to be within the highest category of groundwater emergence due to its proximity to the River Thames alluvial gravels.

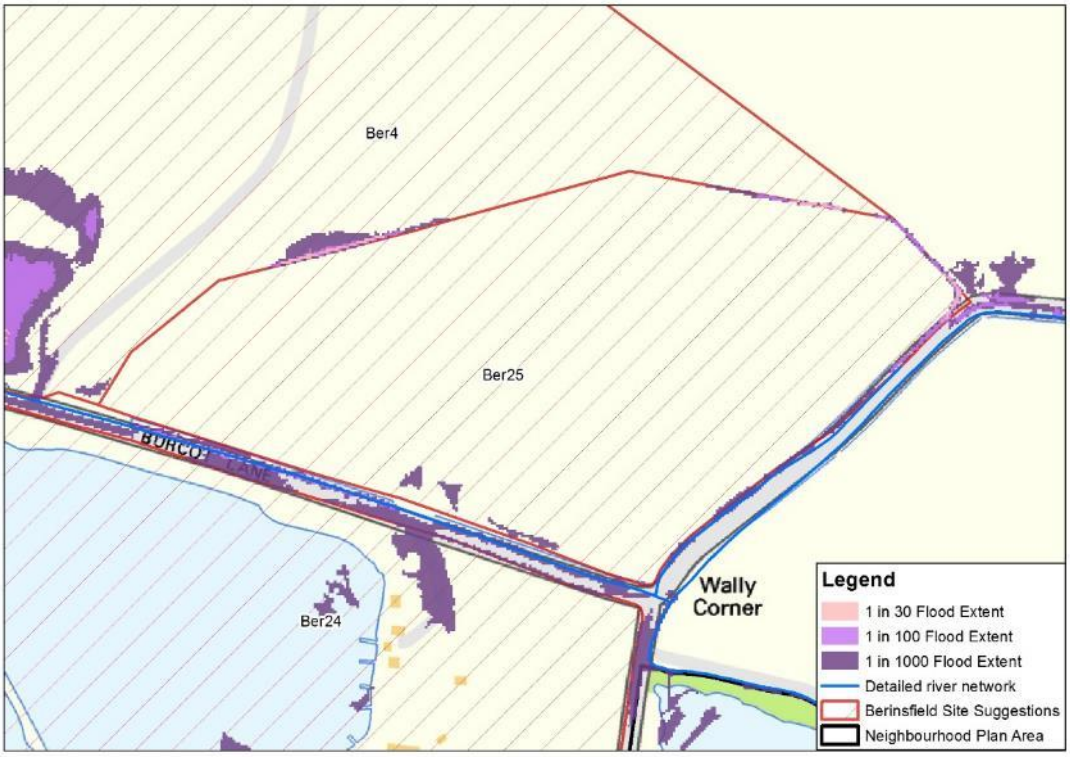
Sewer

No known problems (site is greenfield).

Surface water

The uFMfSW shows small discrete locations of ponding around the edges of the site.

Updated Flood Map for Surface Water



Effects of climate change

Climate change is unlikely to increase the fluvial flood extent significantly (there is little to no difference between the different zones).

Increased rainfall intensity in the future may exacerbate any surface water flooding problems

Wetter winters may increase groundwater flood risk.

Implications for development

- Requires a full FRA for a site in Flood Zone 3.
- It must be demonstrated that the site will be designed sequentially ensuring all development will be outside of Flood Zone 2 with climate change.
- It must be demonstrated that safe, dry access and egress will be available during a severe flood event.
- FRA should include a detailed assessment of groundwater flood risk.
- Opportunities for enhancing the amenity value of the Flood Zone area.
- The development must not increase existing flood risk of the surrounding area. A drainage strategy should be submitted at an early stage to cover mitigation of any surface water risk and reduce impact downstream through site design and SUDS methods. Runoff less than greenfield rates is desirable.
- Thames Water should be consulted at an early stage to ensure that there will be sufficient capacity in the wastewater system and any upgrades are carried out where necessary

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North Yorkshire
BD23 3AE

t:+44(0)1756 799919
e:info@jbaconsulting.com

Jeremy Benn Associates Ltd
Registered in England
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Visit our website
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