Resilience and Flood Risk

WWW.RABCONSULTANTS.CO.UK
enquiries@rabconsultants.co.uk

Bicester Airfield, Bicester, OX26 5HA

FLOOD RISK ASSESSMENT

14/12/2016

Version 1.0

RAB: 1434B

Second Floor, Cathedral House,
Beacon Street, Lichfield WS13 7AA
T. 01543 547 303

Unit 13, St Stephens Court, Willington,
Crook, County Durham DL15 0BF
T. 01388 748 366

Kingsbrook House, 7 Kingsway,
Bedford, Bedfordshire MK42 9BA
T. 01234 363 582

Registered Office: Langard Lifford Hall, Lifford Hall, Lifford Lane, Kings Norton, Birmingham B30 3JN. Registered in England. Company No 5799647. VAT registration No. 884 0481 08

Revision History

Version	Date	Amendments	Issued to
1.0	Dec 16		Oliver Bannister

Quality Control

Action	Signature	Date
Prepared	Alex Cartwright BSc (Hons) Msc Matt Tandy AMInsLM	09/12/2016
Checked	Matt Tandy AMInsLM	12/12/2016
Approved	Ray Pickering CEng MCIWEM C.WEM MCGI MEPS	13/12/2016

Disclaimer

This document has been prepared solely as a Flood Risk Assessment for Bicester Heritage. RAB Consultants accepts no responsibility or liability for any use that is made of this document other than by the client for the purposes for which it was originally commissioned and prepared. No person other than the client may copy (in whole or in part) use or rely on the contents of this document, without the prior written permission of the Managing Director of RAB Consultants Ltd. Any advice, opinions, or recommendations within this document should be read and relied upon only in the context of the document as a whole.

RAB Bedford Office

RAB Consultants
Kingsbrook House
7 Kingsway
Bedford
MK42 9BA

This page intentionally left blank

Contents

This page intentionally left blank

1.0 Introduction

RAB Consultants has prepared this Flood Risk Assessment (FRA) in support of the proposed hotel with associated corporate and leisure facilities at Bicester Airfield, Bicester, OX26 5HA.

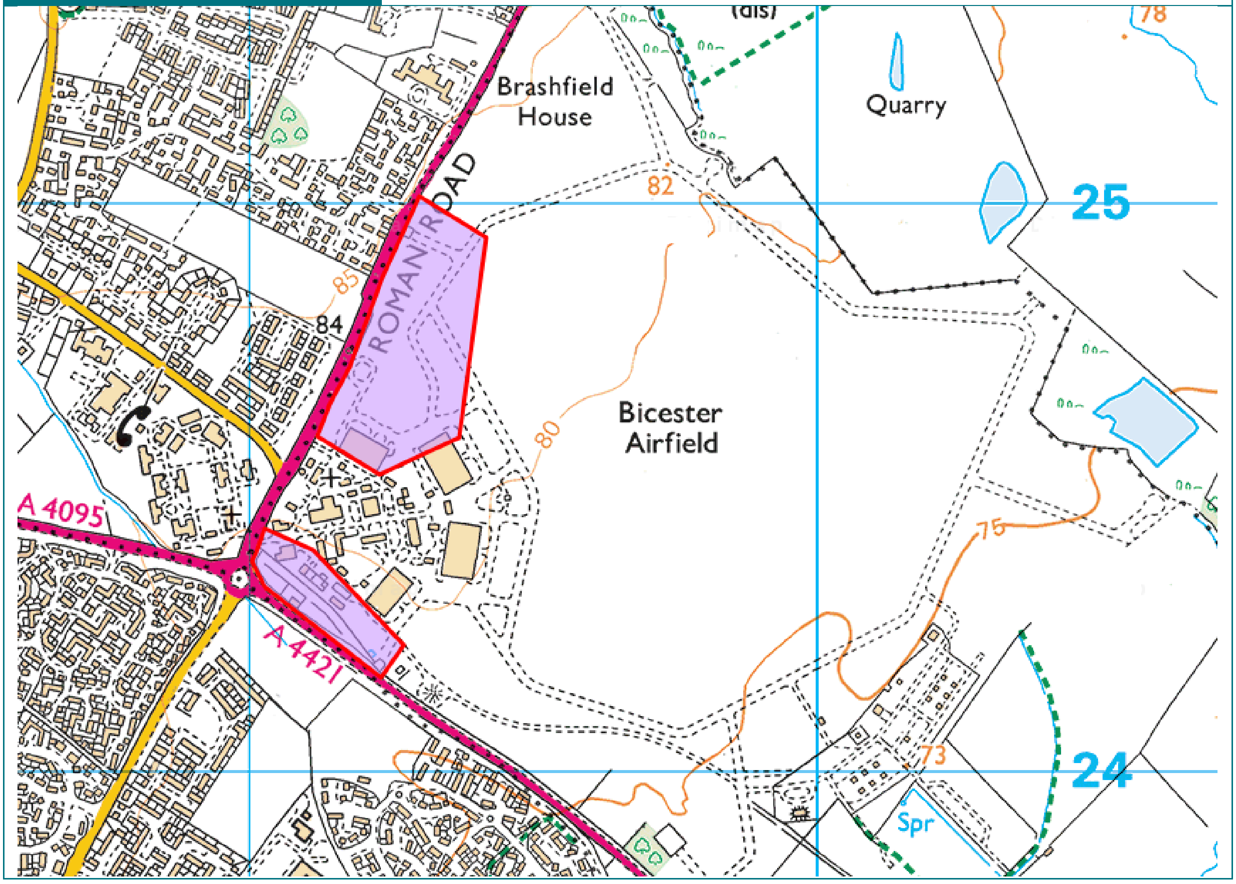
The development site is located in Flood Zone 1 according to the Environment Agency's Flood Map for Planning. The Planning Practice Guidance (PPG) for the National Planning Policy Framework (NPPF) requires a site specific FRA to be carried out for developments located in Flood Zones 2 & 3 and for those which are 1 hectare (ha) or greater in size. A site specific FRA is required to ensure that the development is safe from flooding and will not increase the risk of flooding elsewhere.

2.0 Site Details

2.1 Site Location

TABLE 1: SITE LOCATION

Site Address:	Bicester Airfield, Bicester, OX26 5HA
Existing land use:	Airfield
OS NGR:	459240, 224181
Local Planning Authority:	Cherwell District Council



2.2 Site Description

A site visit was undertaken by RAB Consultants on 12th August 2016, involving a photographic survey and visual assessment of the existing site and surrounding area, on a clear and sunny day. The site is located within Bicester Airfield which is an old RAF airbase situated in the north of Bicester. It shares its western and southern boundary with the A4421 (Figure 1, Figure 2) and the site benefits from three clear access points (Figure 3). The developable area to the west consists of a large grassed area along with sections of the taxiway, currently used as a recreational motorsport track (Figure 4), and an airfield hanger.

The smaller developable area to the south has some grassed areas (Figure 5) and a number of existing buildings (Figure 6). There is a historic carriageway running perpendicular to the A4421 for approximately 200m, which has become unused and overgrown (Figure 7).

The operations manager for Bicester Heritage explained the site benefits from good infiltration and the majority of the airfield is drained to ground. This is supported by the Elm Farm Quarry to the north which is thought to have mined limestone previously. The operations manager also explained that the Ministry of Defence included a combined sewer network within the site which is thought to be utilised by the existing buildings. An access lid for a Klargester was noted within the airfield although not within the proposed developable areas (Figure 10). A well-defined ditch was observed along the southern boundary of the airfield (Figure 9). This is thought to eventually discharge to Langford Brook approximately 1.35km downstream. The upstream channel was grassed and showing signs of having not received fluvial water for some time (Figure 8).

FIGURE 1: SOUTHERN BOUNDARY OF THE SITE

FIGURE 2: WESTERN BOUNDARY OF THE SITE

FIGURE 3: EXISTING ACCESS TO BICESTER AIRFIELD

FIGURE 4: VIEW OF THE DEVELOPABLE AREA TO THE WEST

FIGURE 5: VIEW OF THE DEVELOPABLE AREA TO THE SOUTH

FIGURE 6: AN EXAMPLE OF THE EXISTING BUILDINGS

FIGURE 7: VIEW OF THE HISTORIC CARRIAGEWAY ALONG THE SOUTHERN BOUNDARY

FIGURE 8: UPSTREAM CHANNEL AND CULVERT HEADWALL

FIGURE 9: VIEW OF THE WELL-DEFINED CHANNEL ALONG THE SOUTHERN BOUNDARY

FIGURE 10: EXISTING KLARGESTER UTILISED FOR FOUL WATER

2.3 Development Proposal

The proposed development comprises of a 300-room hotel with associated restaurant, kitchen, lounge, bar and reception areas. This will be complemented with a circa 2,800m^2 conference centre and circa 1,000m^2 leisure facilities. The external grounds will include car parking, utility plant rooms and outbuildings.

3.0 Flood Risk

3.1 Sequential Test

According to the Environment Agency's Flood Map for Planning the site lies in Flood Zone 1; which is land assessed as having less than 0.1% AEP (1 in 1,000 year) of fluvial or tidal flooding.

The NPPF follows a sequential risk-based approach in determining the suitability of land for development in flood risk areas, with the intention of steering all new development to the lowest flood risk areas. NPPF PPG Table 2 confirms the 'Flood risk vulnerability classification' of a site, depending upon the proposed usage. This classification is subsequently applied to Table 3 'Flood risk vulnerability and flood zone compatibility' to determine whether:

- The proposed development is suitable for the flood zone in which it is located; and
- Whether an Exception Test is required for the proposed development.

The proposed development is classed as a *'more vulnerable'* development in accordance with NPPF PPG; therefore, it is appropriate for the Flood Zone.

3.2 Flooding History

No historic flooding has been recorded within the Cherwell District Council Strategic Flood Risk Assessment (SFRA) for the site or surrounding area of northeast Bicester (SFRA, 2009: Appendix B-7). A robust internet search has revealed that flooding has been limited to the southern reaches of the Langford Brook floodplain within Bicester. The Langford Brook is located over 1km east of the site, and roughly 10m lower.

Sewer flooding is often caused by excess surface water entering the drainage network causing sewers to surcharge. Thames Water, who are responsible for the management of urban drainage and sewerage within the Borough, maintain a DG5 register of sites affected by sewer flood incidents on a post code basis. According to the Cherwell SFRA, the site has not been affected by sewer flooding due to failure or capacity issues. It is important to note that previous sewer flood incidents, or the lack thereof, do not indicate the current or future risk to the site. Upgrade work could have been carried out to alleviate any issues or conversely, in areas that have not experienced sewer flooding incidents, the local drainage infrastructure could deteriorate leading to future flooding.

3.3 Fluvial (Rivers)

The Environment Agency online Flood Map identifies the site outside the 0.1% AEP flood extent associated with the Langford Brook. Furthermore, according to the contours from the OS mapping, the site is approximately 10m above the Langford Brook. This natural topography provides protection to the airfield and the majority of Bicester and surrounding land would flood before the proposed development sites.

On the basis of these findings it can be determined the site is not at risk of fluvial flooding.

3.4 Coastal/Tidal

The site is a considerable distance from the sea and therefore is not currently identified at risk of coastal or tidal flooding.

3.5 Pluvial (Surface water)

When the infiltration capacity of land or the drainage capacity of a local sewer network is exceeded, excess rainwater flows overland. This water will collect in topographic depressions and at obstructions, which can inundate development in low lying areas. The severity of the rainfall event, the degree of saturation of the soil before the event, the permeability of soils and geology, and the gradient of the surrounding land and it's use; all contribute to and affect the severity of overland flow.

The Environment Agency Flood Map for Surface Water (Figure 11), can be used to see the approximate areas that would experience surface water flooding from a range of AEPs, which is used to categorise the risk (Table 2).

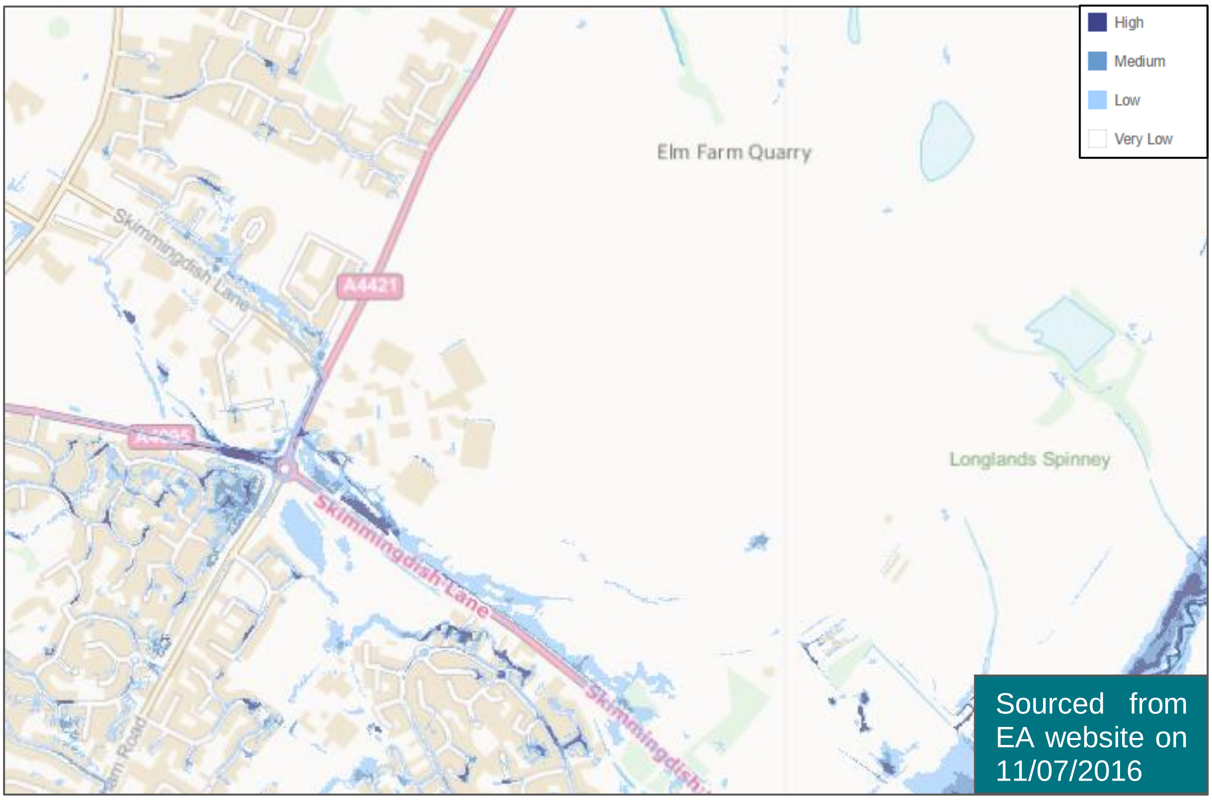


FIGURE 11: ENVIRONMENT AGENCY SURFACE WATER MAP

TABLE 2: ENVIRONMENT AGENCY SURFACE WATER RISK CATEGORIES

Surface Water Risk Category	Surface water flooding Annual Exceedance Probability
Very Low	< 0.1%
Low	Between 1% and 0.1% (1 in 100 years and 1 in 1000 years)
Medium	Between 1% and 3.3% (1 in 100 years and 1 in 30 years)
High	> 3.3% (1 in 30 years)

The surface water maps identify that there is a very low risk of surface water flooding for the majority of the airfield. The northern side of Skimmingdish Lane has been identified as medium to high risk, which is within the boundary of the proposed south site (Figure 12). Within this area is a well-defined ditch which probably provides conveyance for upstream catchments to the west. This water is likely to be making its way towards the Langford Brook. There is also a flowpath identified from the A4421 to the north west, through the site towards the ditch along the southern boundary. It appears to use the historic carriageway as the flow path. The south site is at medium to high risk of surface water flooding.

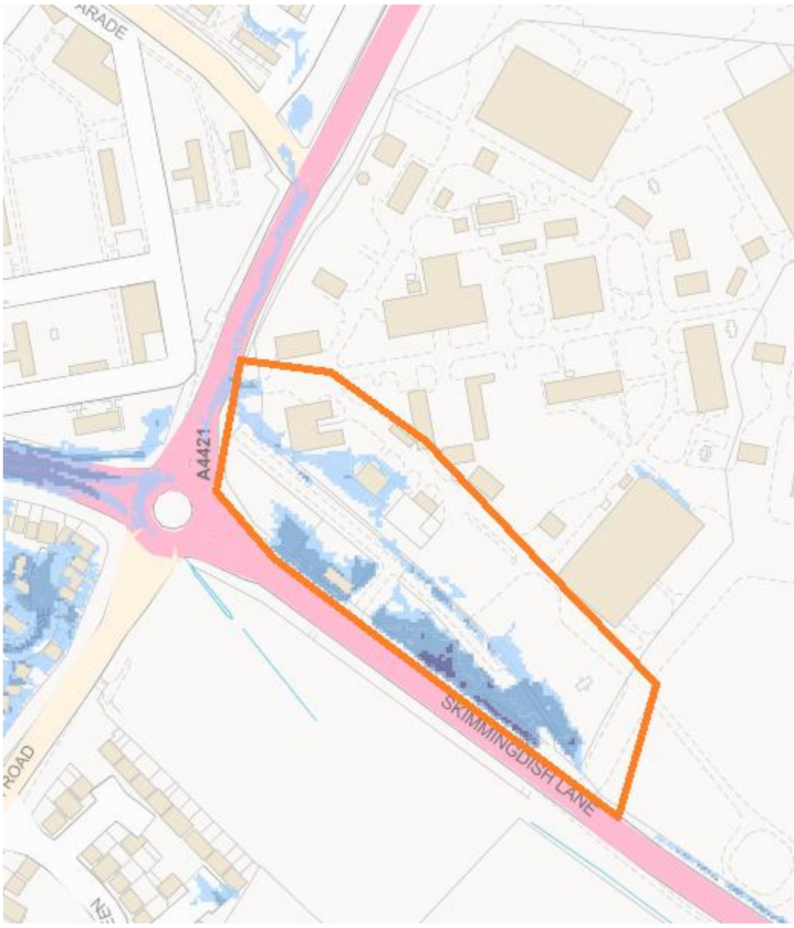


FIGURE 12: ENVIRONMENT AGENCY 1% AEP SURFACE WATER MAP FOR THE SOUTHERN AREA

3.6 Artificial Water Bodies

The site is not identified as being at risk of reservoir flooding from the Environment Agency Reservoir Flood Map. The site is located a considerable distance from any canal and therefore not currently at risk from flooding from this source.

3.7 Groundwater

British Geological Survey (BGS) records indicate that the majority of the proposed development site overlies bedrock composed of Cornbrash Formation – Limestone. The south eastern corner of the site is composed of Forest Marble Formation - Limestone and Mudstone. The BGS does not hold a record of superficial deposits in this area.

According to the Cherwell SFRA (2009), the northeast quadrant of Bicester, which includes the site and surrounding area, is not considered at risk from groundwater flooding. Owners of the site, along with other local members of the public did not mention issues associated with standing water during the winter months. Furthermore, from visiting the site there were no signs of water loving fauna indicative with land exposed to water for prolonged periods. The site is located within the wider slope of the valley, and as such any emerging groundwater would flow under gravity to the east, resulting in minimal flood levels if groundwater did emerge. Both the north and south proposed sites are within a 'Minor aquifer high' according to the Environment Agency's groundwater vulnerability zone mapping.

Groundwater flooding usually occurs following a prolonged period of low intensity rainfall and although the risk is low, it is still a possibility. The future risk from this source is uncertain as climate change predictions indicate that although sea levels will rise, thus possibly raising groundwater levels, and overall summer rainfall will decrease, thus having a long-term effect of lowering the groundwater levels. Long periods of wet weather however are predicted to increase: these are the type of weather patterns that can cause groundwater flooding to occur. On the basis of these findings, the risk of groundwater flooding is understood to be low.

4.0 Mitigation Measures

4.1 Risk to Buildings

4.1.1. Finished Floor Levels

In accordance with BS8533:2011 *'Assessing and managing flood risk in development – code of practice'*, in order to afford a level of protection against flooding it is recommended that finished floor levels should be set at a nominal 300mm above either the 1% AEP of fluvial flooding or the 0.5% AEP of tidal flooding depending on which is greater (both including climate change).

The site is located outside of the 0.1% AEP of fluvial and tidal flooding, with a low risk associated with groundwater. As such surface water risk and infrastructure failure is considered most notable risk to mitigate from. The surface water risk is largely constrained to the topographic low area along the southern boundary where a well-defined, existing ditch is present. The remainder of the two proposed sites areas appear to be largely unaffected.

Industry best practice suggests setting floor levels 150mm above ground level to offer a level of protection against these sources of flooding.

4.2 Risk to Occupiers

4.2.1. Safe Access/Egress

According to PPG NPPF, safe access and egress should be contemplated at this stage in order to ensure that the occupants will be able to leave the property safely in the event of extreme flooding. The site is located outside the area at risk from fluvial flooding and has a low risk associated with groundwater and surface water flooding for the majority of the. During all flood events safe access and egress can be achieved from A4421, in accordance with BS 8533:2011. Access and egress routes would be restricted along the southern boundary due to the surface water risk identified.

4.3 Risk to Others

The proposed development is outside of the 0.1% AEP therefore does not reduce the available floodplain volume. Furthermore, any increase in impermeable area will be mitigated through the surface water drainage strategy.

4.3.1. Existing Flow Path

There is a surface water flow path identified within the site boundary, north of Skimmerdish Lane. The development proposals will need to include an opportunity for this flow path to pass through the site. An option could include its collection and the conveyance along the site's boundary before discharging to the existing ditch.

4.3.2. Surface Water Storage

The site currently provides storage for surface water between the southern boundary and the historic carriageway, as identified by the Environment Agency's Flood Map for Surface Water (Figure 12). Constructing buildings or raising land levels within this flood extent could reduce the available surface water storage and increase the risk of flooding off-site. Development should be steered away from this area unless a scheme to mitigate any impact is incorporated into the final design.

5.0 Surface Water Drainage Strategy

5.1 Existing Surface Water Drainage Arrangements

The operations manager for Bicester Heritage explained the site benefits from good infiltration and the majority of the airfield is drained to ground. The operations manager also explained that the Ministry of Defence included a combined sewer network within the site which is thought to be utilised by the existing buildings for surface and foul water discharge. An access lid for a Klargester was noted within the airfield although not within the proposed development areas.

The existing flow paths for the two proposed development sites generally fall from north west to south east (Figure 13, Figure 14

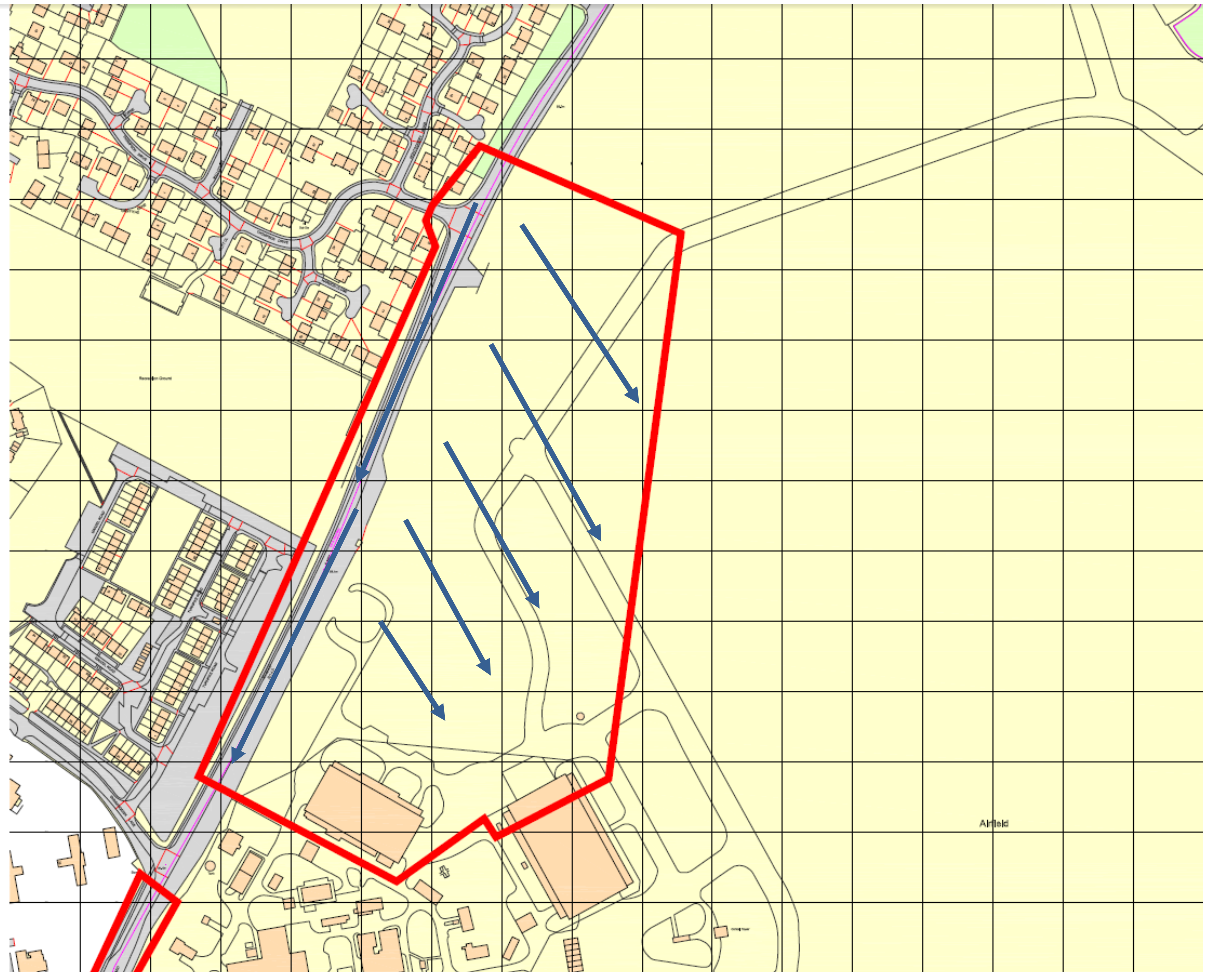


FIGURE 13: EXISTING FLOW PATHS OF WESTERN DEVELOPMENT SITE

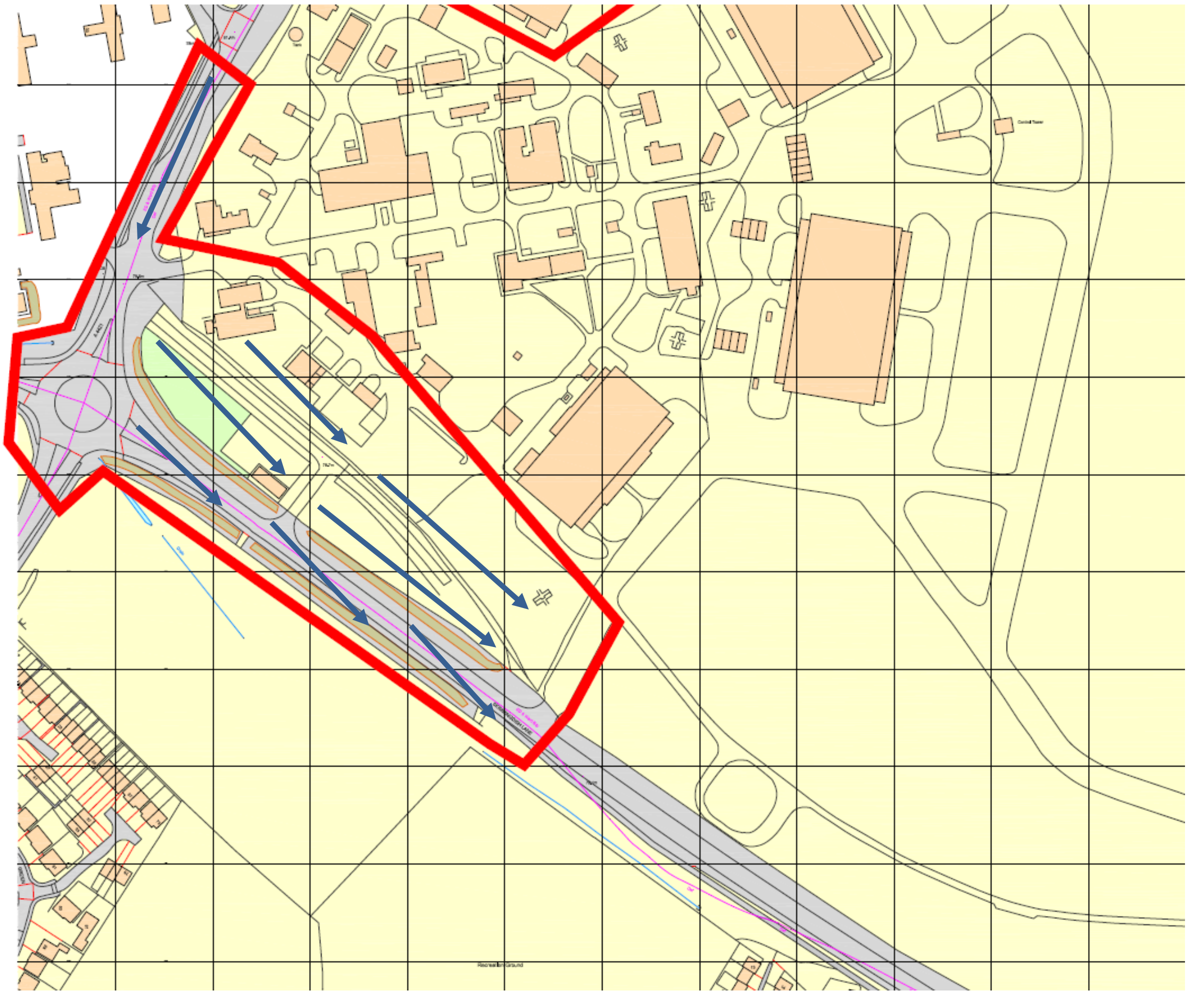


FIGURE 14: EXISTING FLOW PATHS FOR THE SOUTHERN DEVELOPMENT SITE

5.2 Local Policy

Cherwell District Council's local plan for 2011-2031 details their requirements in relations to Sustainable Drainage Systems (SuDS). Policy ESD 7 states;

"All development will be required to use sustainable drainage systems (SuDS) for the management of surface water run-off. Where site specific Flood Risk Assessments are required in association with development proposals, they should be used to determine how SuDS can be used on particular sites and to design appropriate systems. In considering SuDS solutions, the need to protect groundwater quality must be taken into account, especially where infiltration techniques are proposed."

"SuDS seek to manage surface water as close to its source as possible, mimicking surface water flows arising from the site prior to the proposed development."

"In considering SuDS solutions, the need to protect ground water quality must be taken into account, especially where infiltration techniques are proposed."

"Highways SuDS will be adopted by Oxfordshire County Council but must be located on the most appropriate land, requiring consideration of the need to provide access for maintenance purposes, and topographical factors."

5.3 SuDS Feasibility

The development provides an opportunity to incorporate Sustainable Drainage Systems (SuDS) to ensure there is no increased flood risk off-site to third parties as a result of the development.

The SuDS Manual (2015), discusses the SuDS approach to managing surface water runoff which is intended to mimic the natural catchment process as closely as is possible. The approach sets out the design objectives in respect of SuDS:

- Use of surface water runoff as a resource;
- Manage rainwater close to where it falls (at source);
- Manage runoff on the surface (above ground);
- Allow rainwater to soak into the ground (infiltration);
- Promote evapotranspiration;
- Slow and store runoff to mimic natural runoff rates and volumes;
- Reduce contamination of runoff through pollution prevention and by controlling the runoff at source; and
- Treat runoff to reduce the risk of urban contaminants causing environmental pollution

Depending on the characteristics of the site and local requirements, these may be used in conjunction and varying degrees. Table 3 present the functions of the SuDS components (management train) and their feasibility in respect of the site.

TABLE 3: FEASIBILITY OF SUDS TECHNIQUES AT THE DEVELOPMENT SITE

Technique	Description	Feasibility Y / N / M (Maybe)
Good building design and rainwater harvesting	Components that capture rainwater and facilitate its use within the building or local environment.	Yes.
Porous and pervious surface materials	Structural surfaces that allow water to penetrate, thus reducing the proportion of runoff that is conveyed to the drainage system (green roofs, pervious paving).	Yes, green/biodiversity roofs are dependent upon a non-pitched roof design. Pervious surfaces may suitable for the car parks and access roads where their use is low.
Infiltration Systems	Components that facilitate the infiltration of water into the ground. These often include temporary storage zones to accommodate runoff volumes before slow release to the soil.	Maybe. Local reports and BGS geology map suggests the site is underlay by limestone. Infiltration tests need to be undertaken to confirm the rate of infiltration.
Conveyance Systems	Components that convey flows to downstream storage systems (e.g. swales, watercourses).	Yes.
Storage Systems	Components that control the flows and, where possible, volumes of runoff being discharged from the site, by storing water and releasing it slowly (attenuation). These systems may also provide further treatment of the runoff (eg ponds, wetlands, and detention basins).	Yes, above ground storage should be promoted where possible.
Treatment Systems	Components that remove or facilitate the degradation of contaminants present in the runoff.	Yes, surface water should receive multiple treatments, in line with the SuDS Manual 2015, particularly where infiltration systems are to be used.

5.4 Conceptual Surface Water Drainage Strategy

It would appear that infiltration is likely to be feasible as the BGS geology map identifies the site being underlay by limestone, which typically provides good drainage properties. An infiltration test to BRE 365 should be undertaken to ensure the rate of infiltration is a minimum of 10^{-6}m/s. A storage system should be designed based on the infiltration rate identified. This could include infiltration ponds, wetlands or storage within a soakaway sub-base. Above ground storage will need to consider the wider use of the airfield. Permanent waterbodies can invite birds to the area which may present a risk to aviation vehicles and tier users.

Access roads and carpark areas could have an elevated surface towards a filter strip and then a filter drain before infiltrating to ground. The buildings roofs could incorporate a green/biodiversity roof to reduce annual average runoff or a rainwater harvesting system to use the collected water as a resource.

SuDS features designed for managing ground level surface runoff, will need to include appropriate mitigation of the pollution associated with the proposed land use, before infiltrating. This will present an opportunity to promote improved water quality.

Should infiltration be found unfeasible, the surface water could be discharged to the ditch along the southern boundary of the airfield. This should be at a controlled rate, as identified in Section 5.4.1, to ensure the risk from flooding off-site is not increased. This can be achieved by using a control structure such as an orifice plate or hydro-brake. Above ground conveyance systems, such as swales and ditches, should be considered before below ground (piped) systems.

5.4.1. Greenfield Runoff Rate and Volume

In accordance with the NPPF, the development must not increase the risk from flooding to others. The Greenfield runoff rate and volume is calculated to identify the existing discharge characteristics, which the development proposal must mimic to ensure this risk is adequately managed. The pre-development runoff rate was calculated (Appendix C) on a 1ha basis. Using the IH124 method for determining Greenfield runoff rate built into Microdrainage WinDes 2013.1 (including the modification given in the *Interim Code of Practice for SUDS, Chapter 6)*:

- AREA = 1ha
- SAAR = 678mm (obtained from WinDes 2013.1 built in FSR map)
- SPR = 30
- Soil = 0.15
- Pre-development QBAR = 0.4 l/s/ha
- Pre-development peak flow with 100% AEP (1 in 1 year) = 0.3 l/s/ha
- Pre-development Peak flow with 3.33% AEP (1 in 30 year) = 0.8 l/s/ha
- Pre-development Peak flow with 1% AEP (1 in 100 year) = 1 l/s/ha

- Pre-development Peak flow with 1% AEP (1 in 100 year) plus 40% climate change = 1.4 l/s/ha

Using the FSR method to determine rainfall and FSSR 16 fixed percentage runoff model for volume (Greenfield runoff volume analysis module built into Microdrainage WinDes 2013.1; Appendix B):

- M5_60 = 20.000mm
- Ratio R = 0.409
- CWI = 101
- Return period = 1% AEP (1 in 100 year)
- Storm duration = 360 minutes
- Area = 1ha
- PR% = 7.92%
- Pre-development Greenfield runoff volume = 49.09m^3/ha

The QBAR runoff rate for this site is low due to the soil characteristics and the potential for infiltration. Based on a controlled discharge rate of 0.4l/s/ha, between 753m^3 and 906m^3 of storage will be required per hectare of impermeable area. This has been estimated using the quick storage estimate function within Microdrainage (Appendix B).

Depending on the final site choice and developable area, 0.4l/s/ha may not be achievable due to feasibility of incorporating such a flow control device. Should this be the case and infiltration also proven unfeasible, the minimum recommended discharge rate for the whole site is 5l/s due to the risk of blockage to pipework associated with lower rates.

6.0 Conclusion

The proposed development at Bicester Airfield, Bicester, OX26 5HA; is located in Flood Zone 1 as defined in the NPPF. The proposal includes the development of a 300-room hotel with associated restaurant, kitchen, lounge, bar and reception areas. This will be complemented with a circa 2,800m^2 conference centre and circa 1,000m^2 leisure facilities.

On the basis of the available information from the Environment Agency and Cherwell District Council, the site is not identified at risk of flooding associated with fluvial, tidal or groundwater. There is a surface water risk within the south site and development should either be steered away from this area or use it as an opportunity to better manage the risk. Given the level of flood risk to the other areas, industry best practice suggests setting floor levels 150mm above the existing external level to offer a level of protection against these sources.

The proposed development can provide safe, dry access and egress during an extreme flood event. Access and egress along the southern boundary would be challenged due to the surface water risk.

There is a surface water flowpath within the south site which will need to be maintained. Incorporating a conveyance channel along the south west boundary before discharging to the existing ditch would provide this opportunity.

Surface water runoff from the proposed development should be managed using techniques outlined in the conceptual drainage strategy and feasible SuDS identified in Section 0. The local geology suggests there is a high potential for infiltration however this will need to be confirmed with an infiltration test to BRE 365. Should the results of this test be unfavourable, there is a ditch along the southern boundary which could be used to discharge the surface water from the proposed development. The mean greenfield annual runoff rate for the site is 0.4l/s/ha. Based on a controlled discharge rate of 0.4l/s, between 753m^3 and 906m^3 of storage will be required per hectare of impermeable area.

Depending on the final site choice and developable area, 0.4l/s/ha may not be achievable due to feasibility of incorporating such a flow control device. Should this be the case and infiltration also proven unfeasible, the minimum recommended discharge rate for the whole site is 5l/s due to the risk of blockage to pipework associated with lower rates.

It can be concluded that, providing the recommendations in this assessment are adhered to, the proposed residential property will be safe from flooding hazards, not impede the path of flood water, and it will remain safe for its lifetime while not increasing flood risk elsewhere.

7.0 Recommendations

- It is recommended that finished ground floor levels are set 150mm above the external ground level.
- The risk of surface water flooding to the south site will need to be addressed within the design of the scheme. Development should either be steered away from this area or use this as an opportunity to reduce the risk of surface water flooding by providing more efficient drainage features and ensuring that any new proposals do not increase the risk of flooding to others. It is therefore recommended that a detailed study to manage surface water is undertaken.
- A detailed drainage strategy should be developed alongside the proposals for the site. This should be informed by this conceptual strategy and incorporate SuDS identified in Section 5.0.
- Prior to detailed design and submission of a planning application, infiltration tests to BRE Digest 365 must be undertaken to ascertain the infiltration rate of the soil to determine the suitability of infiltration SuDS and inform the design of SuDS features.

Appendix A – Development Proposals

Appendix B – MicroDrainage Calculations