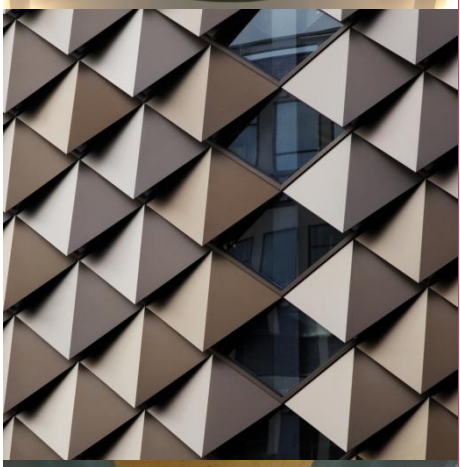
ENVIRONMENTAL STATEMENT

VOLUME 2

APPENDIX 12.1 – FLOOD RISK ASSESSMENT



Proposed Great Wolf Lodge Chesterton, Bicester

Flood Risk Assessment

Curtins Ref: 068535-CUR-00-XX-RP-C-00001

Revision: P02

Issue Date: November 2019

Client Name: Great Lakes UK Limited

Site Address: Land to the east of M40 and south of A4095, Chesterton, Bicester, Oxfordshire OX26 1TE

Curtins Consulting Limited
17-19 Whitworth Street West
Manchester
M1 5WG
Tel: 0161 236 2394
Email: manchester@curtins.com
www.curtins.com

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P01	Preliminary Issue for Comment	MCS	TL	08/10/19
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Author	Signature	Date
Michael Smith MEng (Hons) Senior Infrastructure Engineer	[redacted]	11/11/19

Reviewed	Signature	Date
Tom Leake MEng (Hons) CEng MICE Head of Infrastructure South	[redacted]	11/11/19

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Curtins Consulting Ltd has prepared this report based on the provided and available information. Investigations are required to confirm scope, assumptions and conclusions. The opinions, conclusions and any recommendations in this report are based on assumptions made by Curtins Consulting Ltd described in this report.

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1.0 Introduction

1.1 Overview

Curtins Consulting Limited has been appointed by Great Lakes UK Limited to prepare a site-specific Flood Risk Assessment (FRA) for the proposed development of Great Wolf Lodge, Chesterton, Bicester ('Proposed Development').

Proposals contained or forming part of this report represent the design intent and may be subject to alteration or adjustment in completing the detailed design for this project. Where such adjustments are undertaken as part of the detailed design and are deemed a material derivation from the intent contained in this document, prior approval shall be obtained from the relevant authority in advance of commencing such works.

Where the proposed works, to which this report refers, are undertaken more than twelve months following the issue of this report, Curtins Consulting Ltd shall reserve the right to re-validate the findings and conclusions by undertaking appropriate further investigations at no cost to Curtins Consulting Ltd.

Allowance for the effects of climate change will be made in accordance with government recommendations in place and statistical data available at the time of writing this report. These recommendations may become more onerous and the statistical data may be revised in the future; we will not make any estimate of what changes may result from this. Please be aware that this, and other issues over which the Curtins Consulting has no control, may affect future flood risk at the development and require further work to be undertaken for which we accept no liability.

1.2 Scope of Flood Risk Assessment

The assessment is to be undertaken in accordance with the standing advice and requirements of the Environment Agency for Flood Risk Assessments as outlined in the Communities and Local Governments Technical Guidance to the National Planning Policy Framework (NPPF).

The assessment will:

- Investigate all potential risks of current or future flooding to the Site;
- Consider the impact the Proposed Development may have elsewhere with regards to flooding; and
- Consider design proposals to mitigate any potential risk of flooding determined to be present.

The purpose of this report is to assist our client and the Local Planning Authority to make an informed decision on the flood risks associated with the Site's development. Local Planning Authorities have the powers to control developments, in line with recent legislation, and are expected to apply a risk-based approach to development.

2.0 National and Local Policy Considerations

2.1 National Planning Policy Framework

In recent years, the Government and local authorities have placed increased priority on the need for developers to take full account for the risks of their development at all stages of the planning process. The National Planning Policy Framework (NPPF) and Planning Practice Guidance (PPG) identifies how the issue of flooding is dealt with through the planning process and with the creation of a site-specific Flood Risk Assessment (FRA) for sites over 1ha in area or in Flood Zones 2 & 3.

2.2 Planning Practice Guidance

The Government's Planning Practice Guidance (PPG) provides additional information to be read alongside the NPPF. The online guidance sets out the definitions for the flood zones and defines the permitted uses of development that can be proposed in them. The table below provides a summary of this guidance and refers to Table D.2 in the PPG.

Table 2-1 - PPG Tables 1 & 2 Summary

Flood Zone	Appropriate Users
Flood Zone 1 - Low Probability This zone comprises land having less than 1 in 1000 annual probability of river or sea flooding (<0.1%)	All uses of land are appropriate in this zone
Flood Zone 2 - Medium Probability This zone comprises land assessed as having between 1 in 100 and 1 in 1000 annual probability of river flooding (1%-0.1%) or between 1 in 200 and 1 in 1000 annual probability of sea flooding (0.5%- 0.1%) in any year	The water-compatible, less vulnerable and more vulnerable uses of land and essential infrastructure in Table D.2 are appropriate in this Zone Subject to the Sequential Test being applied, the highly vulnerable uses in Table D.2 are only appropriate in this zone if the Exception Test is passed
Flood Zone 3a - High Probability This zone comprises land assessed as having a 1 in 100 or greater annual probability of river flooding (>1%) or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%) in any year	The water-compatible and less vulnerable uses of land in Table D.2 of the PPG-TG are appropriate in this zone. The highly vulnerable uses in Table D.2 should not be permitted in this zone. The more vulnerable and essential infrastructure uses in Table D.2 should only be permitted in this zone if the Exception Test is passed. Essential infrastructure permitted in this should be designed and constructed to remain operational and safe for users in time of flood.
Flood Zone 3b - Functional 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)	Only the water-compatible uses and the essential infrastructure listed in Table D.2 that has to be there should be permitted in this zone. It should be designed and constructed to: Remain operational and safe for users in times of flood; Result in no net loss of floodplain storage; Not impede water flows; and Not increase flood risk elsewhere. Essential infrastructure in this zone should pass the Exception Test.

2.3 Local Planning Policy Requirements

2.3.1 The Cherwell Local Plan 2011-2031

This FRA has been written in line with the current revision of the Cherwell Local Plan. The plan is aimed to support and guide developments in the area between 2011-2031.

This report has been specifically produced with the following policies in mind;

Policy ESD 6: Sustainable Flood Risk Management

This policy aims to reinforce the guidance set out in the NPPF and outlines Cherwell's requirements for new developments in respect to flooding. As with the requirements of the NPPF, ESD 6 outlines the requirements of site-specific flood risk assessment. The policy states the need of the FRA to demonstrate that there will be no increase in surface water discharge or volume emanating from a site for any event up to and including the 1 in 100 year (plus climate change), it also places the requirement for developments not to experience flooding for any events up to and including the 1 in 30 year storm event, ensuring any flood water is held safely on site.

Policy ESD 7: Sustainable Drainage Systems (SuDS)

This policy aims to promote the use of SuDS for all new developments in the management of surface water runoff. The policy states that;

"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 ground water quality must be taken into account, especially where infiltration techniques are proposed. Where possible, SuDS should seek to reduce flood risk, reduce pollution and provide landscape and wildlife benefits. SuDS will require the approval of Oxfordshire County Council as LLFA and SuDS Approval Body, and proposals must include an agreement on the future management, maintenance and replacement of the SuDS features"

2.3.2 Strategic Flood Risk Assessment

Cherwell District Council produced a SFRA in May 2017 which provides an update on a previous version with new legislative policy and summary of flood risk in Cherwell. The document provides guidelines on use of SuDS and guidance for FRAs. The document requires consideration of groundwater emergence as part of the decision-making process on the type of the SuDS techniques. The list of items to be provided with drainage strategy is included below.

Site Drainage Strategy to include:

- SuDS proposals;

- Outfall locations and levels, including confirmation from relevant authorities that the proposed outfall location will be accepted;
- Rates of discharge including confirmation from relevant authorities that the proposed discharge rate will be accepted;
- On-site storage requirements including storage location indicated within the proposed development plan, confirmation that is it is to be located outside the existing 1% AEP+CC flood extent, and evidence that sufficient space is available; and
- Maintenance, funding and operation proposals for the SuDS.

2.3.3 Oxfordshire Flood Risk Management Plan

Oxfordshire County Council acts as the Lead Local Flood Authority for the county. A Flood Risk Management Strategy has been produced as part of this role, with an aim to;

- Setting out a long-term programme for flood risk reduction.
- Setting out procedures for identifying relative priorities of measures for flood risk reduction.
- Establish how to find area where a holistic approach to flood risk reduction will achieve multiple benefits.
- Establish how to identify affordable measures for implementation to agreed time frames,
- Facilitate engagement and consultation with community and strategic partners.
- Encourage public awareness and self-help where appropriate.

3.0 Existing Site Details

3.1 Location and Description

The Site is currently used as part of an 18-hole golf course associated with Bicester Hotel, Golf and Spa (BHGS). The project proposes to use the north western 9 holes as the Site for the development, turning the existing golf course from an 18 hole to a 9-hole golf course. The Site's main access is currently from the south, via a dedicated entrance of Green Lane. There is a secondary access to the service area from the West off the A4095. The Site planning boundary has a total area of 18.6ha. It is proposed to construct a new part 3, part 4-storey 498 room hotel and waterpark with associated parking for approximately 900 vehicles. The Site will also offer indoor activates, conference facilities, food and beverage hall and public nature trails.

The proposed impermeable area of the development is approximately 7.2ha. This area is made up of the proposed structures and associated hardstanding, areas contributing to the drainage network, car park and access roads.

The Site can be seen in the topographical survey found in **Appendix A,** and the proposed site plan in **Appendix B**.

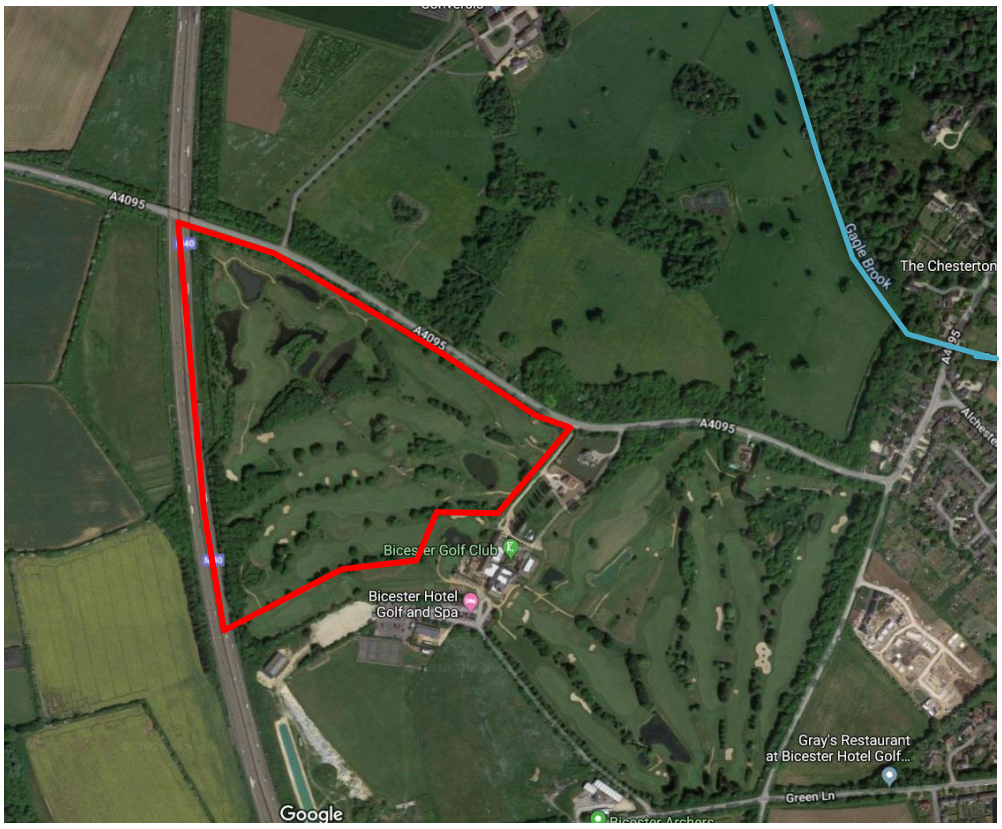


Figure 3-1: Aerial View with Indicative Site Boundary (red) and Gagle Brook (blue)

3.2 Topography

The information provided within the topographical survey enclosed in **Appendix A** indicates that the Site generally grades from north-west to south-east along the A4095 road on the north east boundary of the Site; with levels falling from around 87mAOD to 81mAOD. The Site is a typical golf course with various landscaping features such as ponds, lakes and water features across the Site with the majority located towards the north. The water features on the Site are believed to be fed by groundwater, however further site investigations are required to confirm this.

3.3 Existing Watercourses

The closest watercourse is Gagle Brook (Ordinary Watercourse) located 500m away, to the north east of the Site. This watercourse flows to the south before turning into an EA main river, approximately 2km south of Bicester. Approximately 4km downstream, Gagle Brook flows into the River Ray.

Oxfordshire County Council has produced a Flood Toolkit which identifies the drains and watercourses within the vicinity of the Site. It indicates drains in the south-east boundary of the of the golf course (outside site boundary) connecting to the network of ditches. Another short ditch network in the east within Bignell Park connects to Gagle Brook. Figure 3-2 below shows the ditch networks.

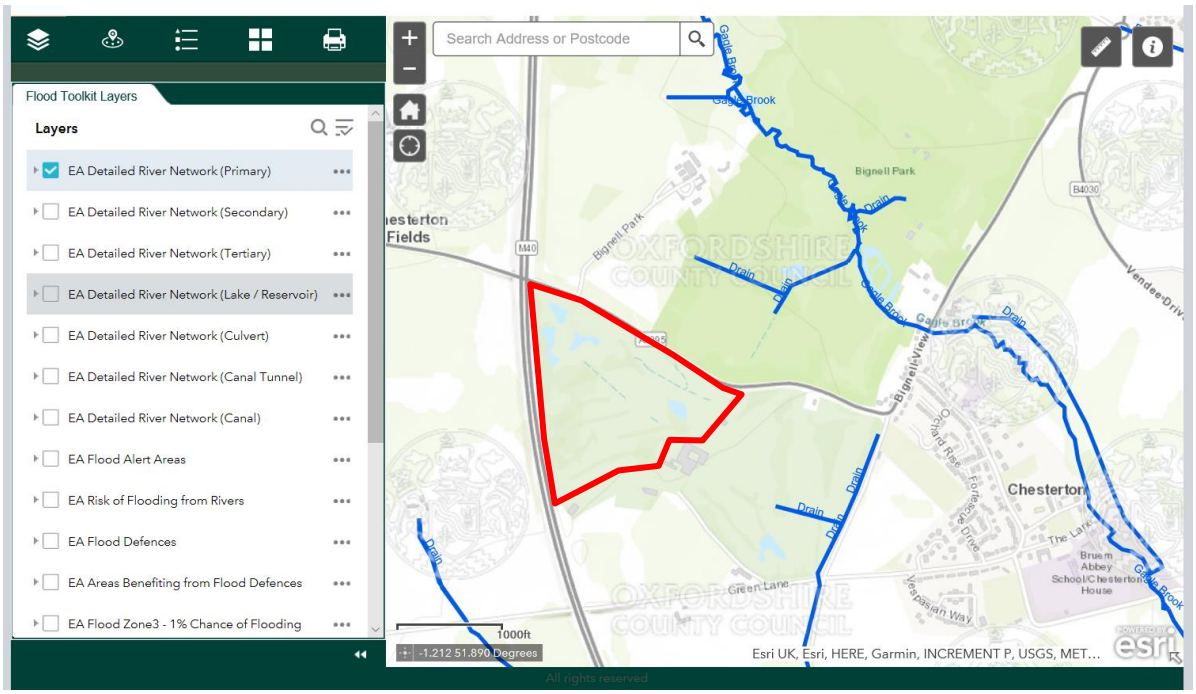


Figure 3-2: Oxfordshire CC Flood Toolkit Extract

3.4 Public Drainage

The Thames Water Asset Location Search indicates that there are no public sewers within the vicinity of the Site. The nearest foul sewer (TW Manhole 7601) is located approximately 500m away to the east of the Site along A4095. It serves the residential area around Alchester Road.

There are no surface water sewers within the vicinity of the Site, there is a surface water network east of the Site in Chesterton. This serves the residential area and discharges to the Gagle Brook. Refer to **Appendix C** for Thames Water asset records and Figure 3-3 below for an extract.

It should be noted that this plan does not include information regarding sewer connections from individual properties or any sewers not owned by Thames Water.

Information regarding the highway drainage for the A4095 has been requested from Cherwell District Council, however their records only showed the gully locations with no below ground information.

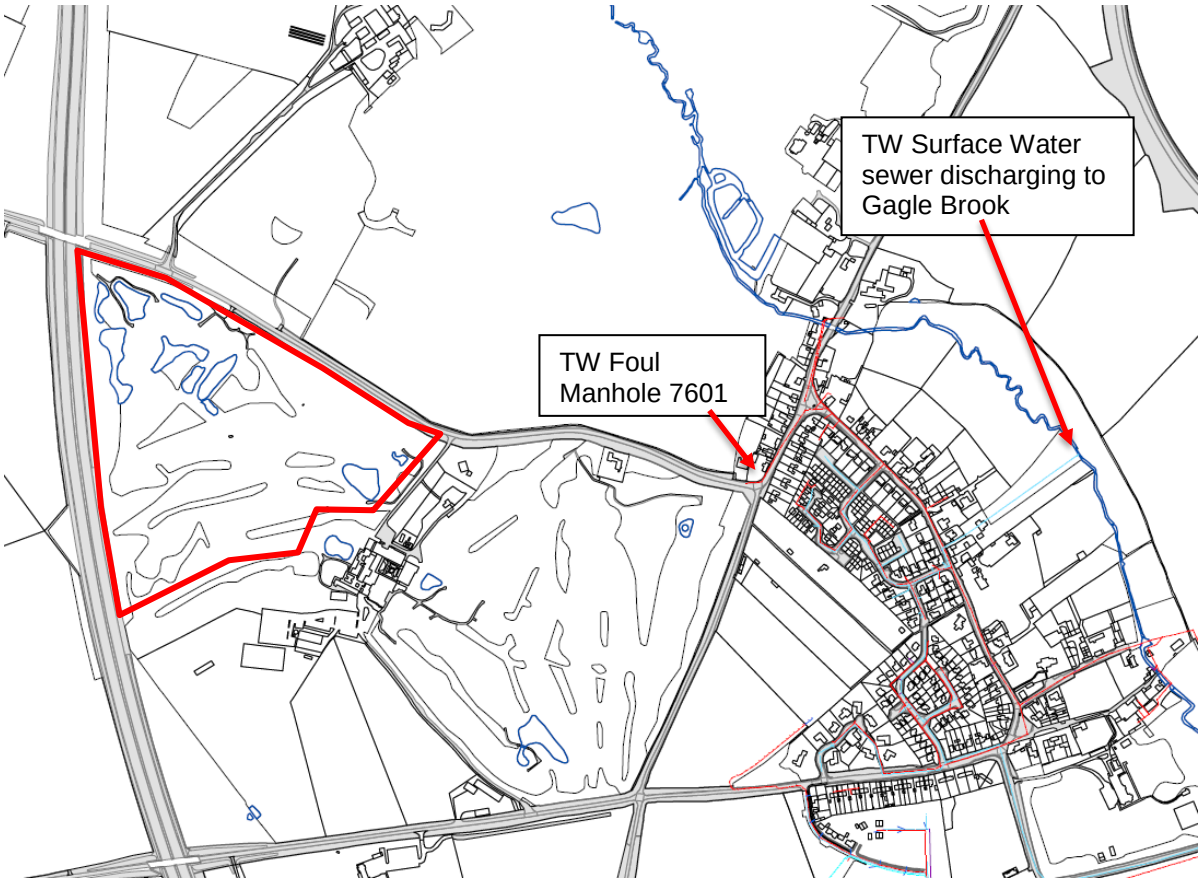


Figure 3-3: Extract of Thames Water Sewer Plans

3.5 Private Drainage

Following a visit to the Site and a walk over with the BHGS site maintenance staff, it has been seen that the BHGS buildings are served by a series of below ground foul water drains. These direct flows to the east and south of the hotel building where foul flows are discharged into pump chambers. From here, sewerage is pumped across the southern 9 holes to the Thames Water foul water manhole 7601 beneath the A4095. It is understood from maintenance staff that the macerator pumps used by BHGS are currently operating at full capacity.

Surface water across the Site is collected via a range of above and below ground systems. There is a ditch network that manages land drainage and overland flow from the golf course and green spaces to the north and south of the hotel.

Roof drainage is managed by guttering and rain water pipes, guiding the surface water to a below ground drainage system. The surrounding hardstanding and car parking areas are drained using road and yard gullies.

All surface water collection systems discharge into an existing pond to the south of the hotel, or further downstream into the network of ditches which flow southward, off site.

Figure 3-4 shows the arrangement of this ditch network. The Site boundary is all drained via two ditches that outfall via a 300mm diameter pipe into a pond to the south of BHGS (labelled northern and southern ditch below). The pond has a high-level outfall discharging to the ditch network shown in Figure 3-5. It is understood that the pond is used for irrigation of the Site in summer. From the available information and following the aforementioned site visits, it is assumed that all surface water is currently discharged from the Site via a series of swales and culverts, leading flows southward to Gagle Brook. Figure 3-5 shows the approximate route, with swales shown in green and culverts in purple. This is the

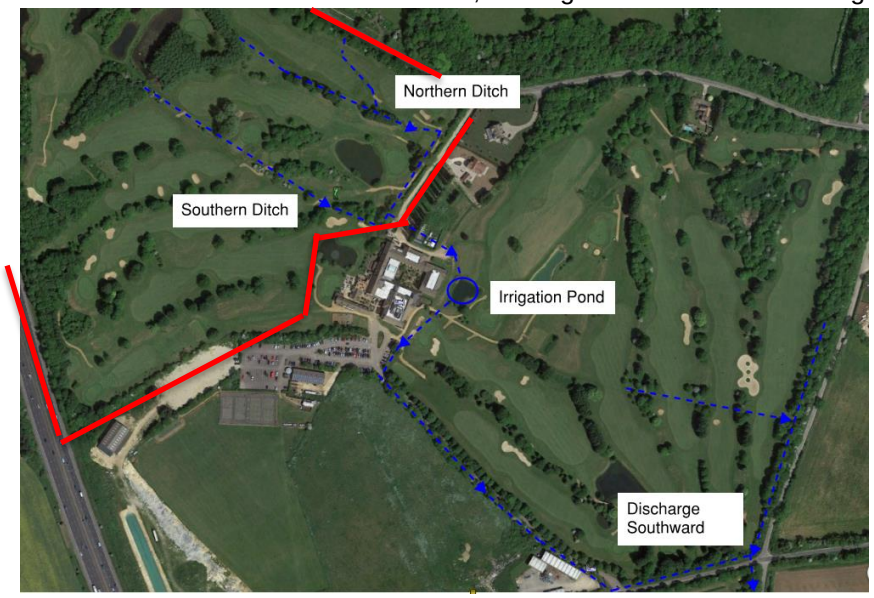


Figure 3-4: Existing Site Ditch Network With Indicative Site Boundary

understanding taken from the flow direction of the ditched on the topographical survey, site walk overs and evidence given by the BHGS's maintenance staff.

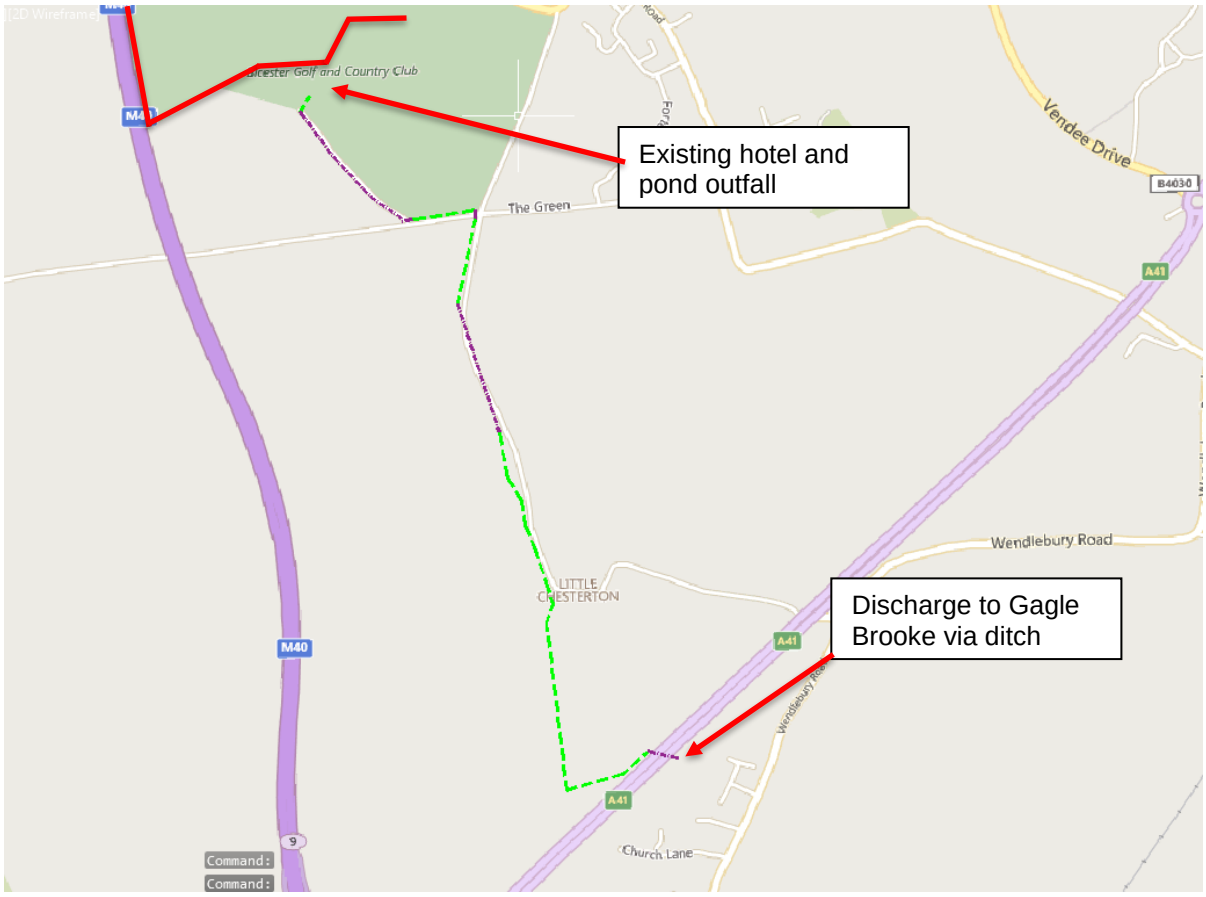


Figure 3-5: Surface Water Discharge Route With Indicative Site Boundary

3.6 Site Geology

The Site is underlain at rockhead by various formations and members of the Great Oolite Group, which are dominated by limestones with subordinate mudstone beds.

The lower part of the Cornbrash Formation is the youngest (uppermost) bedrock unit represented, it comprises limestone with mudstone. Underlaying this is the Forest Marble Formation with the White Limestone Formation beneath that.

The Cornbrash Formation is a local unconfined aquifer and is categorised by the Environment Agency (EA) as a 'Secondary A Aquifer' (permeable layers supporting water supplies and stream base flows). The groundwater in the Cornbrash is perched on the low permeability of the Forest Marble beneath, which acts as an aquiclude, separating the Cornbrash from the White Limestone.

An unmanned aerial vehicle (UAV) survey was conducted across the Site to better understand the groundwater levels in the Cornbrash. An extract of the results is shown in The drawing is shown in **Appendix D**.

Figure 3-6. It can be seen that groundwater levels to the east and south of the Site are close to the ground surface. The drawing is shown in **Appendix D**.

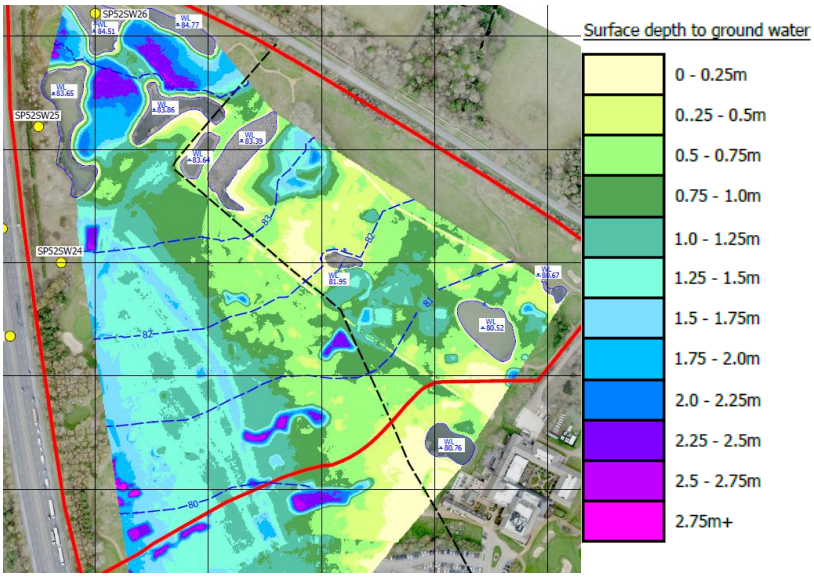


Figure 3-6: UAV Groundwater Survey

4.0 Sources and Extents of Flooding

Numerous sources of flood risk need to be assessed to be in line with the requirements for planning under NPPF and Environment Agency requirements. This report takes into consideration fluvial flooding (rivers and streams), pluvial flood risk (surface water), tidal flooding (coastal or estuarine), reservoir flooding, groundwater flooding, infrastructure failure flooding and any historical flooding reports.

4.1 Natural Drainage

4.1.1 Fluvial Flooding

The Environment Agency's (EA) Flood Map for Planning shows that the Site is located within Flood Zone 1 - Low probability of flooding. This zone comprises of land assessed as having less than a 1 in 1000 annual probability of river or sea flooding. All classifications of vulnerable developments are allowed within this zone. Since the Site area is larger than 1 ha, this FRA will investigate other sources of flood risks for the development.

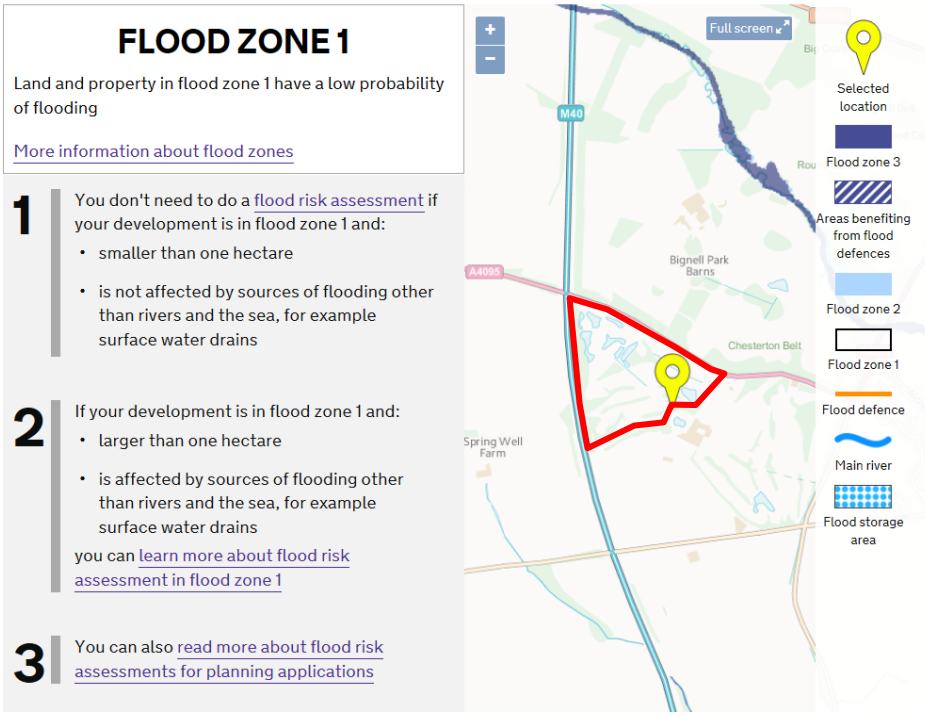


Figure 4-1: Environment Agency Flood Zone Map

There is no flood risk from the Gagle Brook Watercourse reported in Environment Agency's flood maps or local authority flood maps to the Site.

The risk to Site from fluvial sources is therefore considered as low.

4.1.2 Pluvial Flooding and Overland Flow

Surface water flooding occurs when intense rainfall is unable to soak into the ground or enter drainage systems, because of blockages, or breakages in the sewer pipes or where drainage capacity has been exceeded.

The Environment Agency's online mapping shows no flood risk from surface water within the Site as shown in Figure 4-2 below. Therefore, flooding risk from surface water is considered low for this Site.

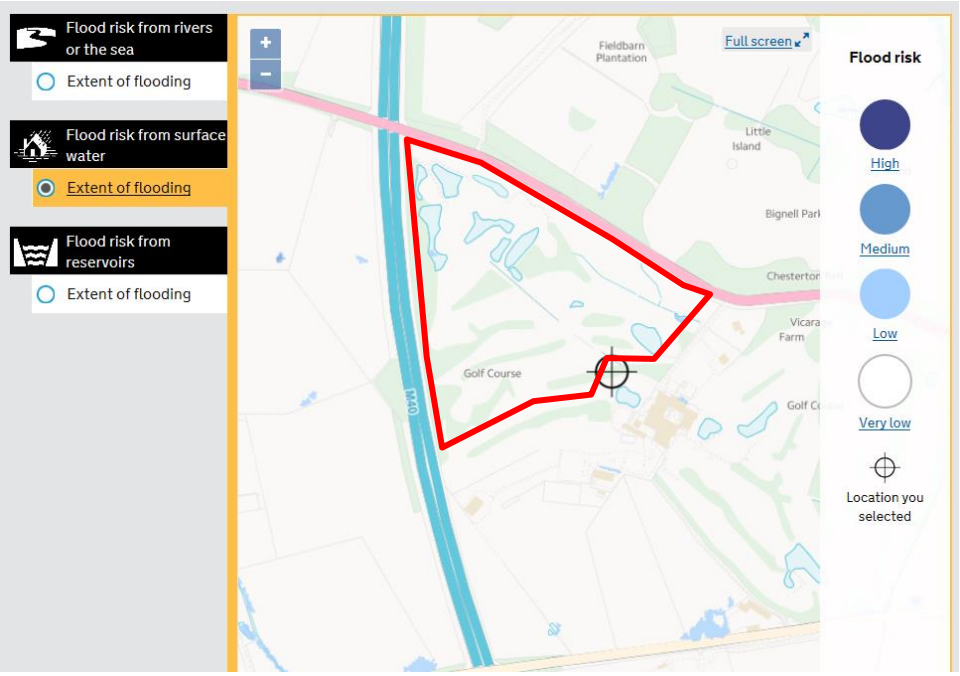


Figure 4-2: Risk of flooding from surface water

4.1.3 Groundwater Flooding

As previously discussed, the Site geology creates a perched groundwater table within the uppermost geology beneath the Site – the Cornbrash Formation. This groundwater is perched by the Forest Marble aquiclude beneath.

The Site is occupied by a number of ponds, largely to the north with some in the south. These ponds are assumed to be fed by groundwater and offer an insight into the groundwater levels. The information contained in Figure 4-3 shows the groundwater levels across the Site, inferred from the pond levels, the full drawing is shown in **Appendix E**.

Cherwell and West Oxfordshire SFRA notes that the Site is underlaid by minor aquifer with high vulnerability. The SFRA contains a list of potential development sites and includes locations from Chesterton, where the sites are not considered to be materially affected with regards to groundwater flooding. The Site location area has not been identified with any previous flooding incidents.

Figure 4-3: Site Topography and Inferred Groundwater Levels

While groundwater flooding may not result in an immediate flood hazard due to the slow rate at which seepage occurs, it has implications on the viability of infiltration methods as a means for surface water disposal and on the design of sub-structures. Any SuDS design will be carried out considering the high groundwater levels. Certain SuDS methods such as infiltration techniques might be unsuitable for the Site.

Whilst initial indicators highlight that areas of the Site are at risk of high groundwater; further site investigations will be required to monitor the change in groundwater level seasonally.

The Site is considered to be at moderate risk of groundwater flooding.

4.1.4 Climate Change

Climate change will impact on fluvial and pluvial flooding. Flood extents may not significantly increase; however, it can become more frequent.

The effect of climate change on groundwater flooding has a more significant influence on winter flood flows. Wetter winters may increase the frequency of groundwater flooding, but drier summers may counteract this effect by drawing down groundwater levels.

The Environment Agency's new climate change guidance has been considered in this development to ensure that flows during the 100-year event are retained within the Site. The surface water drainage system will be designed considering a return period of 100 years plus 40% climate change event.

4.2 Artificial Drainage

4.2.1 Adopted Drainage

Sewer flooding occurs when the sewer is overwhelmed by heavy rainfall, becomes blocked or is of inadequate capacity, and will continue until the water drains away.

Asset location search for Thames Water assets has shown that there are no sewers within the vicinity of the Site. Cherwell and West Oxfordshire Level 1 SFRA records no sewer flooding for site location.

Oxfordshire County Cand Cherwell District Council as the Highway Authority is responsible for the drainage of public streets and ensuring that drains, kerbs, road gullies and the pipe network which connects to the public sewers are maintained.

The proposed drainage strategy explains the discharge locations in detail following the discussions with Thames Water and LLFA.

The Site therefore has a very low risk of flooding from adopted sewers.

4.2.2 Private Drainage System

The Site does not currently have any hardstanding that is positively drained. However, there is a network of land drainage across sections of the Site. This network has been seen to exist during a site walk over and can be seen on aerial mapping available online.

Figure 4-4: Aerial Imagery Showing Evidence of Land Drainage

It is anticipated that the extents of this land drainage will affect the flow profile of surface water emanating from the Site, and as a result, increase the peak discharge from that of a greenfield site.

Existing land drains will collect surface water falling on the south eastern areas of the golf course and convey them to the ditch system running across the Site, faster than would occur on an undeveloped site.

4.2.3 Highway Drainage

Highway drainage information has been requested from Oxfordshire County Council, however their records only contained the location of gullies. As the surrounding highways are not at an elevated risk of surface water flooding, as demonstrated in section 4.1.2. it is assumed that there is a low risk of flooding to the Site by the surrounding highway drains.

4.2.4 Reservoir Flooding

The EA's online mapping shows no flood risk from surface water within the Site as shown in Figure 4-5. Therefore, flooding risk from reservoirs is considered low.

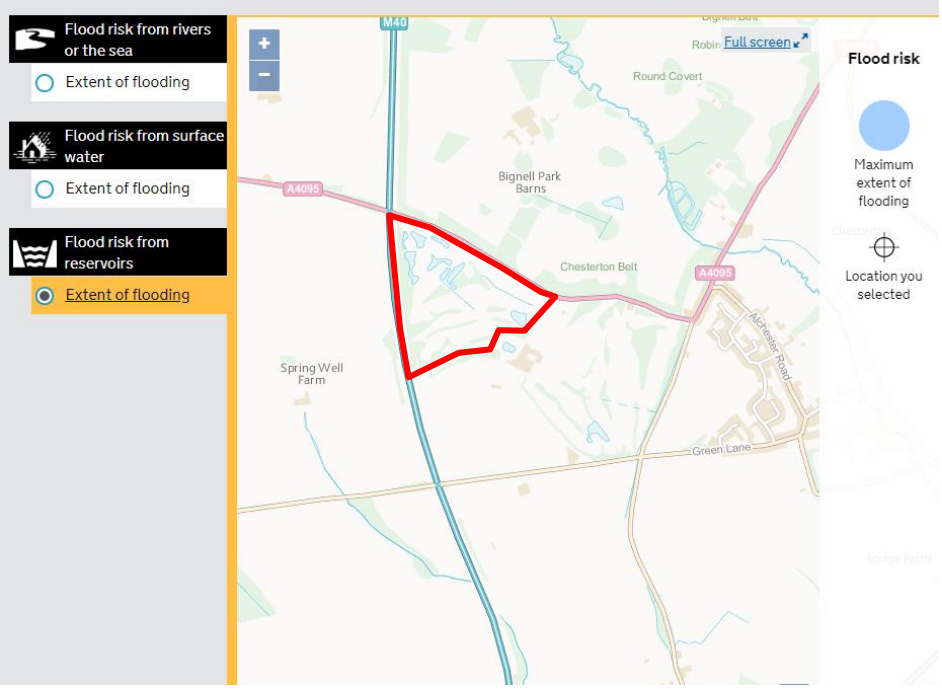


Figure 4-5: Risk of flooding from reservoirs

4.3 Exceedance Flooding Flow paths

As the Site currently has no formal below ground surface water drainage, the only exceedance flows will be overland flows created when rainfall is unable to infiltrate into the ground. Due to the Site topography, this water will flow south east towards the existing ditch network outlined in Section 3.5. This will then be led southward off the Site towards Gagle Brook. These routes are shown in Figure 4-6.

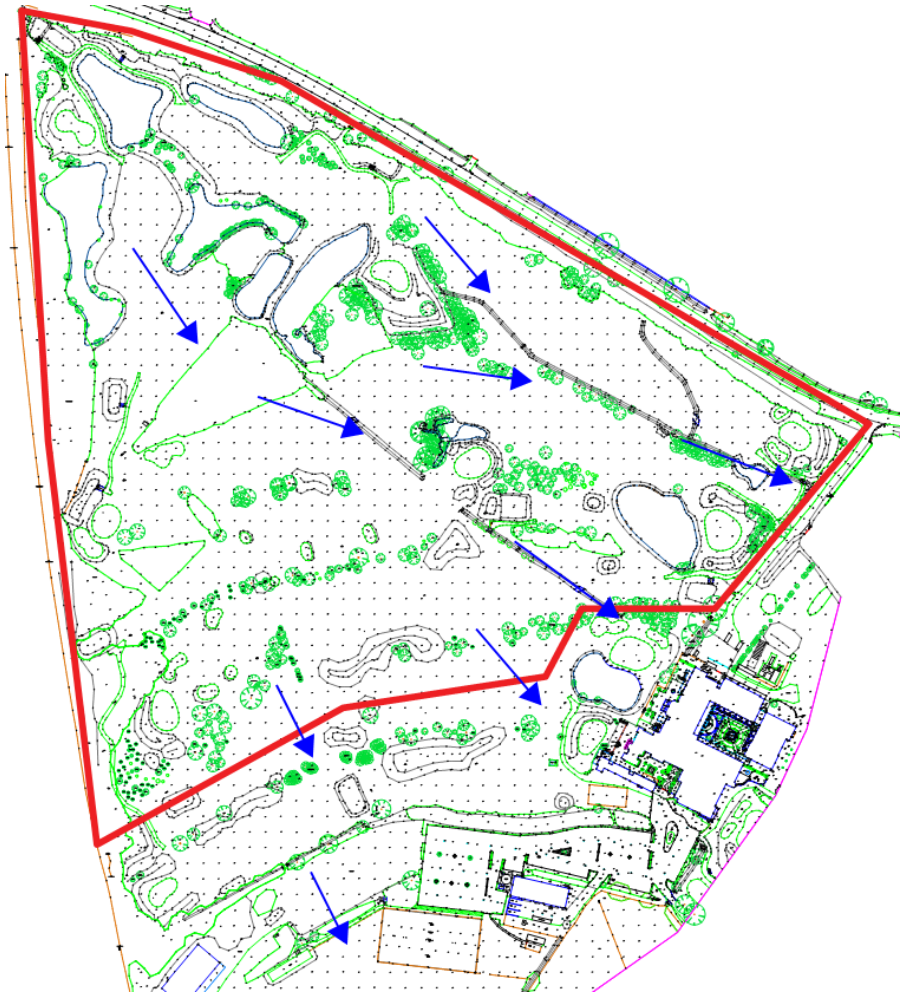


Figure 4-6: Overland Flow Paths

5.0 Flood Risk Mitigation

This section responds to the major risks outlined to the undeveloped site in Section 4 and offers mitigating measures that will aim to reduce the risk of flooding to the Site, as well as sites both up and downstream. The proposed Drainage Strategy drawing is contained in **Appendix F** and further discussed in Curtins Below Ground Drainage Strategy document (068535-CUR-00-XX-RP-C-00002).

5.1 Natural Drainage

5.1.1 Fluvial Flooding

With reference to the Environment Agency's published flood maps (see Figure 4-1: Environment Agency Flood Zone Map in section 4.1.1) the Site can be shown to be in Flood Zone 1.

The sitewide surface water network is proposed to discharge into a network of existing ditches and drains, which in turn discharge to Gagle Brook. As the Site is in Flood Zone 1, there is a low risk of flooding from rivers and the sea already, it is therefore seen as acceptable to discharge via this route.

The risk to the Site from fluvial flooding therefore remains low and unchanged. As the Site is currently positively drained and unrestricted however, the proposed restriction will decrease fluvial flood risk downstream

5.1.2 Pluvial Flooding and Overland Flow

The proposed development will include SuDS features to optimise the impermeable area and manage levels to direct flows away from buildings. It should be noted that the proposed levels will not increase flood risk to other properties.

Oxfordshire LLFA have produced a 'Local Standards and Guidance for Surface Water Drainage on Major Development in Oxfordshire' which outlines the SuDS features and suitability for different scenarios. This standard will be used to inform the drainage design.

For the purpose of considering flood risk and drainage, the Site is classified as a greenfield site; however, the Site is not completely undeveloped and does benefit from some formalised drainage networks. The existing ditches that cross the Site appear to have been constructed as land drainage in the 1980's. Historical mapping from the period shows no surface features on the site, whereas later mapping shows the ditches. See Figure 5-1. Furthermore, there are no inlets into the ditches along their length, except from shallow, small diameter perforated pipes used to drain the fairways of the golf course. Evidence of these land drains can be seen on aerial mapping (see Figure 4-4).

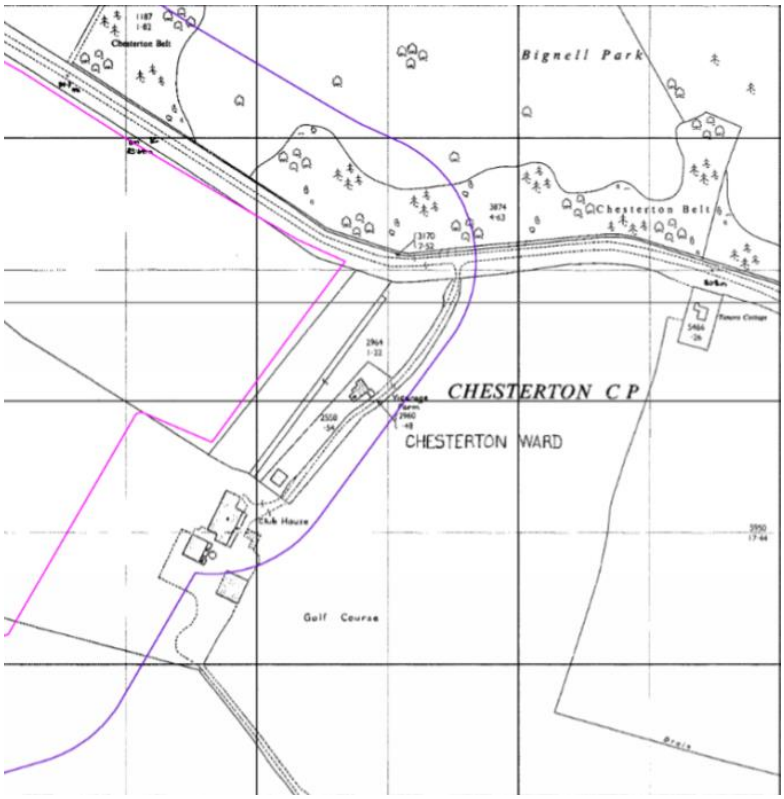


Figure 5-1: Historic Mapping (circa 1980's)

Because of this drainage, the discharge profile from the existing site will not behave in the same way as an undeveloped “greenfield” piece of land. The presence of shallow land drains and the ditches will reduce the run-off’s time of concentration. The Proposed Development is to discharge surface water via the existing ditch network at a rate no greater than QBAR, with excess flows being attenuation in on-site storage features. This is therefore seen to reduce the risk of surface water flooding across the Site as it is anticipated the undeveloped site would discharge at a rate higher than QBAR for comparable rainfall events.

The Site is at a low risk of surface water flooding, the Proposed Development is expected to reduce this further and offer flood reduction benefits for properties downstream of the development.

5.1.2 Groundwater Flooding

Initial non-intrusive site surveys have indicated that areas of the Site are at an elevated risk of groundwater flooding. The south east of the Site is at the greatest risk, with the UAV survey indicting groundwater levels to be as close as 300mm to the surface.

The Ssite’s groundwater levels are managed using land drainage in this area. The Site maintenance staff have constructed two 300-1000mm deep ditches across the east of the Site (running from north to south). Shallow, small diameter perforated pipework has then been laid across the Site, in all

directions, discharging into the ditches. These ditches flow south and meet in an inspection chamber before being culverted.

The Proposed Development proposes the removal of this existing land drainage system. Surface water to the south of the Site will instead be managed by the proposed below ground surface water system, with a new land drainage system to be installed. The location of this is to be similar to the existing system, albeit installed at a lower level to offer better protection to the highway sub-bases in the proposed car park. This can be seen in **Appendix G**. The proposed levels in the south east section of the Site are also proposed to be raised by up to 500mm, this will offer protection to both the groundwater and the car park construction.

The existing ditches are not connected to any of the ponds in the northern part of the Site and no evidence of flows through them were observed during the site walk over. Whilst further intrusive testing is required, it is understood that these ponds are groundwater fed and therefore will have some hydraulic connection to the existing ditches.

To ensure that these ponds are unaffected by the development, it is proposed to install a swale to the north of the car park, with an invert level equal to that of the existing ditches. This will replicate the existing arrangement and maintain groundwater levels in the area. Further to this, two swales are proposed to run from north to south across the car park, these are installed as diversions to the existing ditched on the Site, and will act as an exceedance flow path, mimicking the existing arrangement. These are shown in **Appendix F.**

The Proposed Development therefore is seen to reduce the groundwater flood risk to the south east of the Site but leave it unchanged to the north. The north of the Site is to remain undeveloped and therefore any groundwater flooding is seen to have a low impact and pose no risk to property or person. The adjacent M40 is served by two filter drains at the edge of each carriageway. The depth or capacity if this is not known, however there is no evidence of groundwater flooding along this section of the M40. The area to the north is also at a lower risk of groundwater flooding than the area to the south of the Site.

It is recommended that a site wide intrusive investigation is carried out alongside long term groundwater monitoring, to ensure that the proposed drainage design does not alter the groundwater levels to the north or increase them to the south.

5.1.3 Climate Change

As discussed in Section 4.1.4, all designs will be based on an allowance of 40% increase in rainfall intensity for future climate change.

5.2 Artificial Systems

5.2.1 Adopted Drainage

The proposed surface water network does not discharge to an adoptable surface water sewer, neither is there any in the vicinity. The risk of flooding from adoptable sewers is therefore seen as negligible.

The proposed foul water system is to be discharged via a gravity network to a private pumping station at the south east corner of the Site. The foul water is then to be pumped via rising main to the nearest Thames Water foul sewer, approximately 500m away from the Site. Initial discussions with Thames Water have concluded that there is a capacity issue with this sewer and that the network will require fortifying. The correspondence with Thames Water can be seen in **Appendix H**. As the Site has not yet achieved planning, Thames Water will not begin the modelling process. This will be initiated following the planning process. Any emergency storage requirements associated with the pumping station will be agreed with building control at a later design stage. It is also proposed to offer back up power and pump supply to the pump stations in the event of failure.

As there are no public sewers on the Site, the risk of flooding from the Thames Water network is negligible. There is a heightened risk downstream in the foul network due to the aforementioned capacity issues, however Thames Water have confirmed they will mitigate this post planning.

5.2.2 Private Drainage

The only private drainage on the Site is the previously discussed land drainage and ditch network. As this has been discussed in Section 5.1.2, it will not be discussed further here.

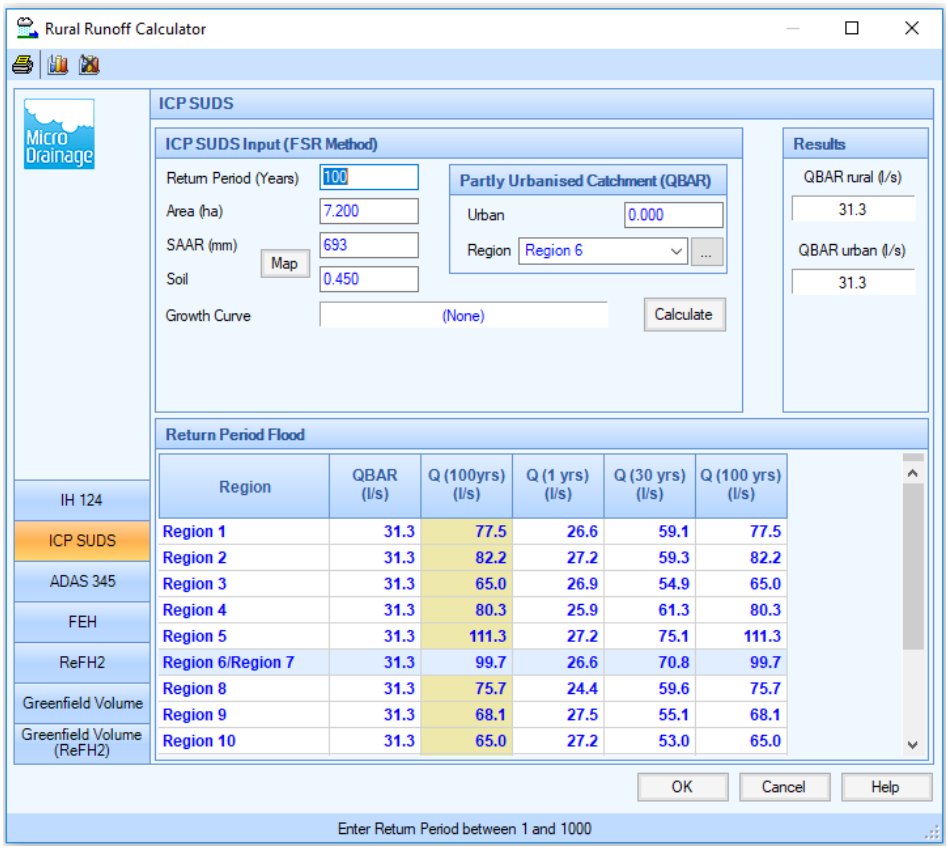
Downstream of the Site, the flood risk to the private systems will be reduced as the maximum discharge rate flowing from the proposed site will be reduced to QBAR.

5.2.3 Highway Drainage

The A4095 runs along the eastern boundary of the Site and is positively drained using gullies. Sewer information was requested from Cherwell District Council, however the provided plans only highlighted gully locations. There have been no reported instances of flooding along this road and the surface water flood risk is shows as very low on the Environment Agency's online mapping. As the highway level is higher than the Site, there is no risk of flooding to the highway by the Site.

5.2.4 Development Drainage

It will be necessary to provide a suitably designed storm water drainage system to collect, convey and attenuate the additional runoff generated by the development of this Site. The Site is proposed to discharge at QBAR, with a rate of 31.3l/s. The calculations for this are shown in Figure 5-2.



Region	QBAR (l/s)	Q (100yrs) (l/s)	Q (1 yrs) (l/s)	Q (30 yrs) (l/s)	Q (100 yrs) (l/s)
Region 1	31.3	77.5	26.6	59.1	77.5
Region 2	31.3	82.2	27.2	59.3	82.2
Region 3	31.3	65.0	26.9	54.9	65.0
Region 4	31.3	80.3	25.9	61.3	80.3
Region 5	31.3	111.3	27.2	75.1	111.3
Region 6/Region 7	31.3	99.7	26.6	70.8	99.7
Region 8	31.3	75.7	24.4	59.6	75.7
Region 9	31.3	68.1	27.5	55.1	68.1
Region 10	31.3	65.0	27.2	53.0	65.0

Figure 5-2: QBAR Calculations

The excess surface water is to be attenuated in storage features across the Site. This is further discussed in the Below Ground Drainage Strategy (068353-CUR-00-XX-RP-C-0002).

This strategy should also include measures to improve run-off quality whilst maximising biodiversity and amenity to provide a sustainable drainage system as noted in PPG.

Foul flows from the development should be drained through an entirely separate system designed to adoptable standards to minimise the risk of foul flooding occurring as a result of the development.

The proposed drainage strategy is seen to reduce the flood risk to the Site and to properties downstream.

5.3 Summary

The pre and post development flood risks are summarised in Table 5-1. As outlined in this report, the proposed development is not expected to increase any form of flood risk to the Site, or up or downstream of it. The Site's surface water will be managed using flow controls and above and below ground storage features.

Table 5-1 - Flood Risk Summary

Potential Source of Flooding	Is there a flood risk to the existing site?	Is the flood risk increased or decreased by the development?	Does the proposed development increase or decrease the flood risk downstream?
Fluvial Flooding	No	No Change	Decreased
Pluvial Flooding	No	Decreased	Decreased
Groundwater Flooding	Yes	Decreased	No Change
Adopted Drainage	No	No Change	No Change
Private Drainage	No	Decreased	Decreased
Highway Drainage	No	No Change	No Change
Reservoir Flooding	No	No Change	No Change
Development Drainage	No	Decreased	N/A

6.0 Sequential Test

As the development site is shown to be wholly within Flood Zone 1 and outside the influence of any other local flood risk elements, in accordance with Table 3 of the PPG, it is concluded that the development is suitable for this location and the Sequential Test is deemed to have been passed.

7.0 Conclusions and Recommendations

7.1 Overview

This Flood Risk Assessment has been prepared for the proposed development located on the land to the east of the M40 and west of the A4095, near Chesterton. The FRA has been prepared in accordance with the requirements of the NPPF.

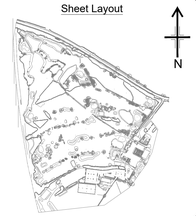
- The Site is located in Flood Zone 1 and is therefore at the lowest risk of fluvial flooding
- The Environment Agency's online mapping shows the Site to be at the lowest risk of surface water flooding.
- There is a very low risk of reservoir flooding to the Site.
- The Site is at an elevated risk of groundwater flooding to the south east. This is managed using a network of ditches and shallow, small diameter perforated land drains. Evidence given by site staff and from historic mapping suggest these drains were installed in the 1980's.
- Other than the above, there is no private drainage on the proposed site.
- The Bicester Hotel, Golf and Spa is served by a separate foul and surface water sewer. The surface water is discharged to the outfall ditch network shown in Figure 3-5, there is no evidence of any restrictions or attenuation on the Site. The foul network is discharged into two pump chambers and pumped via rising main to the Thames Water sewer near Chesterton.
- There are no adopted sewers on the Site, the closest being a Thames Water foul sewer, approximately 500m away.
- The proposed drainage strategy is seen to offer a reduction in flood risk to all sources. It has been designed to ensure no flooding during a 1 in 100 year event +40% allowance for climate change.
- The proposed below ground drainage strategy will restrict discharge rates to QBAR and store excess surface water in above and below ground storage structures.
- The proposed network will utilise storage basins, permeable pavements and swales.
- The groundwater to the south east of the Site is proposed to be managed using a network of land drains installed beneath the proposed car parks sub-base as well as through the diversion of the two drainage ditches through the site. Groundwater levels are to be maintained in the north.

Appendices

Contents

Appendix A – Topographical Survey

Sheet Layout



Topographic Abbreviations

AV	Air Vent	IL	Invert Level
BB	Belisha Beacon	JB	Junction Box
BD	Back Drop	KO	Kerb Outlet
BK	Brick	LB	Litter Bin
BL	Base/Bed Level	LP	Lamp Post
BOL	Bollard	MH	Man Hole
BP	Brick Pillar	MK	Service Marker
BPV	Brick Paviour	MT	Mercury Telephone Cover
BR	Bike Rack	OSBM	Ordnance Survey Benchmark
BS	Bus Stop	P	Post
BT	BT Inspection Cover	PB	Post Box
C	Combined (Sewer)	PCP	Pedestrian Control Point
C&W	Cable & Wireless	PLT	Planter
CA	Camera	PM	Parking Meter
CAJB	Cable Junction Box	PPL	Parapet Level
CATV	Cable Inspection Cover	PU	Pump
CB	Control Box	RE	Rodding Eye
CC	Comms Cabinet	RL	Ridge Level
CCTV	Close Circuit Television	RS	Road Sign
CD	Cable Duct	RW	Retaining Wall
CG	Cattle Grid	RWC	Rain Water Channel
CH	Coal Hole	RWP	Rain Water Pipe
CIP	Cable Inspection Point	S	Storm (Sewer)
CL	Cover Level	S/A	Soakaway
COL	Column	Sap	Sapling
Conc	Concrete	SB	Sliding Bollard
CP	Catch Pit	SC	Water Stop Cock
D	Depth	SD	Service Duct
DK	Drop Kerb	SEG	Side Entry Gully
DPC	Damp Proof Course	SL	Sill Level
EB	Electricity Control Box	SP	Sign Post
EJB	Electricity Junction Box	ST	Stay Cable
EL	Eave Level	SV	Stop Valve
ELEC	Electricity Inspection Cover	SW	Soil Vent Pipe
EM	Electric Meter	SWI	Swimming Pool
EP	Electricity Pylon/Pole	TB	Telephone Call Box
ER	Earth Rod	TBM	Temporary Bench Mark
F	Foul (Sewer)	TC	Traffic Control Inspection Cover
FB	Flower Bed	TH	Trial Hole
FC	Fuel Cover	THL	Threshold Level
FH	Fire Hydrant	TIC	Telephone Inspection Cover
FL	Floor Level	TJB	Telephone Junction Box
FLT	Floor Light	TL	Traffic Light
FO	Fibre Optic	TMC	Tarmac
FP	Footpath	TOW	Top of Wall
FRL	Flat Roof Level	TP	Telegraph Pole
G	Gully	TS	Tree Stump
GAS	Gas Inspection Cover	UTL	Unable To Lift
GJB	Gas Junction Box	VP	Vent Pipe
GM	Gas Meter	WL	Water Level
GP	Gate Post	WM	Water Meter
GV	Gas Vent	WO	Wash Out
HL	Head Level	WP	Waste Pipe
IC	Inspection Cover	WTR	Water Inspection Cover

Topographic Legend

- Gate
- Paving
- Bottom Of Batter
- Top Of Batter
- Building/Wall
- Drip/Vegetative Line
- Slab/concrete
- Slope of batter
- Kerb
- Pipes
- Fencelines
- Vegetative Border
- Railing
- Pin Kerb
- Overhead Power Line
- Building Canopy
- Grass Edge
- Contour With Level
- Edge of Hardstanding
- Bore Hole
- Tree
- Bush
- Survey Station
- Photograph Origin

Utility Abbreviations

AR	ASSUMED ROUTE	NVV	NO VISIBLE VALVE
D.O.C	DEPTH OF COVER	TPR	TAKEN FROM RECORDS
D.T.B	DEPTH TO BOTTOM	TLS	TRAFFIC LIGHT SENSOR
D.T.S	DEPTH TO SOLE	UNA	UNABLE TO GAIN ACCESS
D.T.W	DEPTH TO WATER	UTL	UNABLE TO LIFT
EOS	END OF SONDE	UTS	UNABLE TO SONDE
EOT	END OF TRACE	UTT	UNABLE TO TRACE
EUD	EMPTY UTILITY DUCT		
M.A.R	MAN ACCESS REQUIRED		
NVP	NO VISIBLE PIPE		

Utility Legend

- FUEL LINE - PETROL
- FUEL LINE - DIESEL, KERO OR PARAFFIN
- ELECTRICITY CABLE
- HIGH VOLTAGE ELECTRICITY CABLE
- WATER SUPPLY PIPE
- GAS
- TELECOM CABLE
- BT CABLE
- CABLE TELEVISION
- FIBRE OPTICS
- CATHODIC PROTECTION
- DUCTING
- HEATING PIPES
- SURFACE WATER DRAIN
- FOUL WATER DRAIN
- COMBINED DRAIN
- UNIDENTIFIED (LOCATED USING GPR) - SEE NOTES
- UNIDENTIFIED (LOCATED BY INDUCTION) - SEE NOTES
- UNIDENTIFIED (LOCATED BY RADIO) - SEE NOTES
- UNIDENTIFIED PIPELINE
- TANK GAUGE LINE OR COMMS CABLE
- OFF-SET FILL
- VENT PIPE
- OIL PIPE
- REMEDIATION PIPES
- VAPOR RECOVERY
- SURVEY EXTENTS BOUNDARY LINE
- END OF TRACE/SONDE

Chamber Extents

Report Photos

Notes

THE ACCURACY OF BOTH THE RADIO DETECTION EQUIPMENT AND THE GROUND PENETRATING RADAR, CAN ONLY BE ASSUMED TO BE +/-15% OF THE LOCATED DEPTH. FOR BOTH X,Y AND Z HEIGHT INFORMATION.

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Manchester
M1 5WG

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Great Wolf Lodge,
Chesterton, Bicester,
OX26 1TH

Title:
Great Wolf Lodge
Topographic Survey
Overall Layout

Surveyed:	RD, RL, DF	CAD:	ABR, RD
Ch'k'd:	ABR	App'd:	JG
Date:	02.08.19	Scale:	1:100@A0

1ST HORIZON

1st Horizon Surveying and Engineering Ltd.

The Old Pop Factory
88-90 High Street
Dodworth
Barnsley S75 3RQ

Tel: +44 (0)1226 766 446
Fax: +44 (0)1226 766 317
www.1sth.co.uk
info@1sth.co.uk

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Appendix B – Proposed Site Layout