CATALYST BICESTER

WENDLEBURY ROAD, BICESTER

Site-Specific Flood Risk Assessment & Drainage Assessment

Issue 3

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B A I L E Y

J O H N S O N

H A Y E S

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			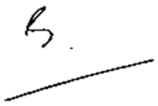	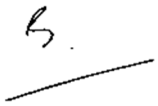
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			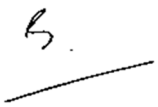	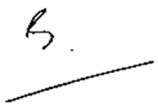
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		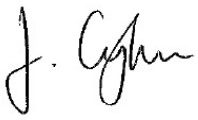	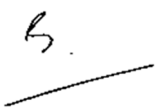	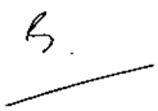

Limitations

All comments and proposals contained in this report, including any conclusions, are based on information available to BJH Consulting Engineers during investigations. The conclusions drawn by BJH Consulting could therefore differ if the information is found to be inaccurate or misleading. BJH Consulting accepts no liability should this be the case, nor if additional information exists or becomes available with respect to this scheme.

Except as otherwise requested by the Client, “Albion Land (Three) Ltd”, then BJH Consulting Engineers is not obliged to and disclaims any obligation to update the report for events taking place after:-

(i) The date on which this assessment was undertaken, and
(ii) The date on which the final report is delivered

EXECUTIVE SUMMARY

Background

Bailey Johnson Hayes Consulting Engineers Ltd. was commissioned by Albion Land (Three) Ltd in November 2018 to prepare a Flood Risk Assessment (FRA) for a proposed Hybrid development at Catalyst Bicester, Wendlebury Road.

The site is approximately 18.4ha in size and is classified as predominantly Greenfield with a small brownfield chicken farm of approximately 2ha in the west. The site is bounded by the Langford Brook to the east, Bicester Avenue Garden Centre to the north, Wendlebury Road to the west and Promised Land Farm to the south. The proposed development comprises of; 13 Business Units for uses such as offices, research, development and appropriate light industry; health and racquets club with associated parking, tennis courts, air dome, swimming pools and terrace; highway works including new roundabout and access road; creation of a wetland and landscaped areas.

Flood Risks

An assessment of historical flooding at the site has been undertaken. Table 4.1 of the 2017 Level 1 SFRA identifies a number of historical flood events which have occurred in Bicester. None are thought to have to have flooded the development site.

The Level 1 SFRA produced by CDC Council and the Environment Agency flood maps show that the site lies within Flood Zones 1, 2 and 3.

The NPPF classifies buildings in class B1 and D2 such as offices, storage, distribution, light industry and leisure as “Less Vulnerable” and their construction is permitted within Flood Zones 1, 2 and 3a.

Flooding from groundwater and sewer / drainage sources are considered to represent a low flood risk to the site.

Surface water flooding is currently considered to represent a low flood risk to the site. Development of the site will, however, increase the area of impermeable surfaces and increase surface water flood risk if additional runoff is not attenuated.

Flood Compensation

The proposed development is shown to encroach within the 100-year plus 35% climate change floodplain. As such, a level-for-level floodplain compensation scheme is provided up to the 1000-year floodplain in order to provide betterment of the existing flood storage capacity.

In a 1000-year event, approximately 7446m^3 of floodplain capacity would be lost as a result of the development. Multiple areas within & outside of the floodplain have been selected to provide approximately 7878m^3 of floodplain compensatory volume during the same flood event. This provides betterment to the 1000-year event by 432m^3 of additional volume. Intermediate water levels generated during more frequent flood events (20-year event) will benefit from up to 121m^3 of additional floodplain capacity.

The effect of the proposed level-level floodplain compensation scheme was modelled by JBA in February 2020 and concluded that, the proposed floodplain compensation scheme completely offsets the impact of the raised development plateaus and does not generate any detrimental impacts across third-party land. Given that the Flood Compensation Scheme is taken to the 1000-year flood event then additional floodplain storage is given during more extreme flood events.

Mitigation of Flood Risk

The level-for-level floodplain compensation scheme will ensure that the built area of the development remains above of the 1,000-year flood event level, while bettering existing flood storage volumes.

All building finished floor levels are proposed to be set at a minimum of the 100-year + 35% climate plus 300mm freeboard so no less than 64.49m AOD. In addition, safe access and egress will be provided to Wendlebury Road with the construction of a new roundabout and associated estate roads above the 100-year + 35% level. FFL's proposed by BJH are in the order of 64.75 – 65.00 m AOD.

It is recommended during construction that the Contractor will sign up to Environment Agency's flood warning service and locate stockpiles outside the 1 in 1000 year flood extent.

A flood evacuation and management plan should be undertaken during detailed design to manage the risk flooding posed to the landscaped areas with access for people, animals and other wildlife.

Climate Change

The latest Thames region river flow allowances for Zone 3 were last defined in 2016. Sites within the category of 'central' indicate an increase of 25% and 'higher central' of indicate 35% increase for climate change projections up to '2080s'. The worst case climate change scenario of 35% has been extensively modelled by JBA consulting in order to fully analyse the effects of climate change. The mitigation measures described above reduce the risk of climate change to an acceptable level.

Surface water drainage has adopted allowances for climate change as the total potential change anticipated for the '2080s' is between 20 - 40%. Adopting these allowances will prevent flooding in future unknown events. An allowance of 40% has been adopted in order to provide the most sustainable design.

Surface Water Drainage & SuDS Strategy

The proposed Surface Water Drainage Strategy will attenuate surface water runoff to a Greenfield rate of 20 litres / second for all storm events up to the 1 in 100-year + 40% climate change event. Due to the low soil permeability rate, surface water will be discharged into the Langford Brook via pre-existing ditches or watercourses. Surface water from roof areas will discharge via downpipes or siphonic drainage systems into the on-site drainage system. Crushed stone blankets will be located beneath car parks utilising permeable paving construction to provide at source SuDS attenuation. All other highways, estate roads, yards and hardstanding will be have surface water conveyance to attenuation swales.

All attenuated runoff from the site will be discharged into the Langford Brook at the 1 in 1 year Greenfield flow. In fluvial flooding events, devices will be installed to prevent flood waters entering the surface water systems. The crushed stone blankets and storage basin will both provide treatment of runoff. Additional treatment will be provided from permeable paving in car parks. Multiple hydro-brake will be utilised in order to gain maximum attenuation in sub-catchments from SuDS features.

Benefit to Third Party Land

The proposed surface water drainage strategy and level-for-level floodplain compensation scheme will result in a reduction in fluvial flows leaving the site during both surface water and fluvial flood events. Residents downstream at the Promised Land Farm will benefit from these peak flow attenuations.

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1.0 INTRODUCTION

1.1 This Flood Risk Assessment (FRA) is compliant with the requirements set out in the National Planning Policy Framework (NPPF) and the associated Planning Practice Guidance. This FRA has been produced on behalf of Albion Land (Three) Limited in respect of a review of the Flood Risk in the location know as Catalyst Bicester or previously named as "Bicester 10" in the Cherwell local plan.

Table 1.1 - Site Summary

Site Name	Catalyst Bicester
Location	Wendlebury Road, Bicester
NGR (approx.)	457500, 221000
Development Type	Class B1 offices for technological industries, storage & production buildings with associated yards, car parking and estate roads. A small section in the north to be allocated for Class D2 leisure and racquet club with its own separate access and car parking facilities.
NFFP Vulnerability	Less Vulnerable
EA Flood Zone	Flood Zones 1, 2 and 3a
EA Office	North Thames – Banbury
LPA	Cherwell District Council
LLFA	Oxfordshire County Council

Sources of Data

1.2 This report is based on the following information:

(i) Proposed Masterplan Layout
(ii) Topographical Survey Data
(iii) Ordnance Survey Mapping Data
(iv) Environment Agency Product 4 Flood information
(v) Cherwell Level 1 & 2 Strategic Flood Risk Assessments
(vi) Site Investigation & Ground Investigation
(vii) Bailey Johnson Hayes – Flood Compensation Scheme
(viii) Bailey Johnson Hayes – Surface Water Drainage Design
(ix) JBA Consulting – Flood Risk Impact Assessment

The Existing Site (Formally Promised Land Farm)

1.3 The current existing site is located to the South of Bicester in the Cherwell District of Oxfordshire. The site is bounded by Wendlebury Road to the west with Bicester Gateway development currently taking place adjacent. Bicester Avenue shopping centre is to the north, Langford brook to the east with protected wildlife wetland on the opposite side of the brook and Promised Land Farm to the south of which consists of agricultural open fields. The total area of development 'Catalyst Bicester' is approximately 18.4 Ha. (See Figure 1.1).

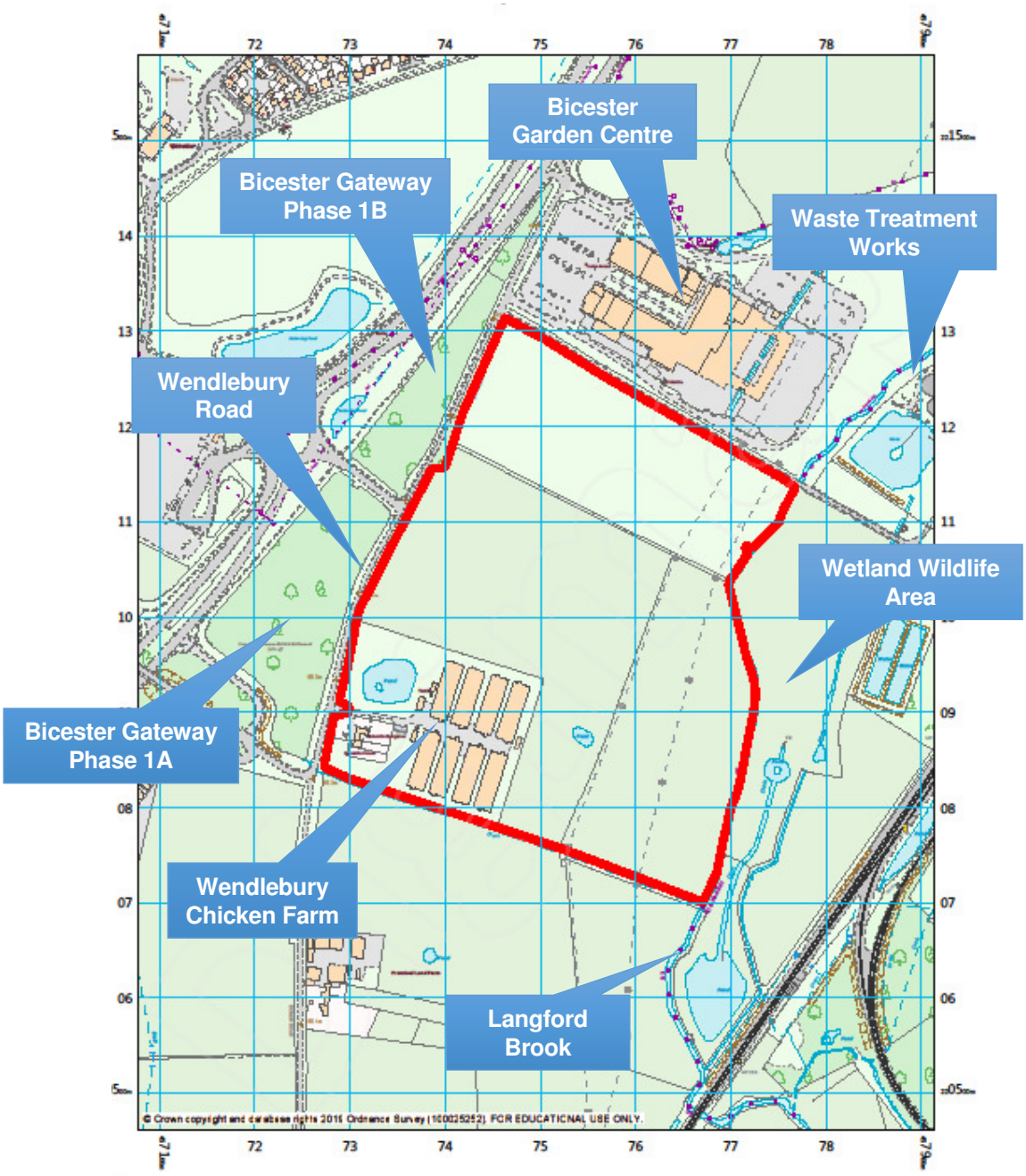

Figure 1.1 - Site Location

1.4 The existing site currently comprises of three undeveloped grassed fields understood to be used for grazing by cattle. Historically agricultural ditches within hedgerows and site boundaries have allowed surface water runoff to drain into the Langford Brook. Electricity Pylons are situated to the west of the site and run from north to south across the entire length of the development. The western region of the site has been identified as having cultural heritage value (formally an Iron Age-Romano British Settlement), although archaeological digs carried out in early 2019 found nothing of significance.

1.5 In the south-western corner of the site there is an existing chicken breeding farm which has been established for approximately 40-50 years. This compromises of eight large chicken houses which are 60m x 20m x 3m high in stature each, as well as associated concrete hardstanding. Inside the farm area there is also a large man made pond circular in shape of 50m in diameter. This does not appear to connect to the Langford Brook or any associated drains/watercourses.

1.6 To the west of Catalyst Bicester is a new development consisting of Phase 1 of the proposed new business park ("Bicester Gateway") comprising up to 14,972 sq m (Gross External Area) of B1 employment based buildings, plus a hotel (up to 149 bedrooms), with associated infrastructure, car parking and marketing boards. While this development is not directly associated with Catalyst Bicester, it does look to achieve joint objectives set out in Cherwell local development plans for the Bicester 10 Policy.

1.7 Topographic survey data from June 2018, updated in January 2020 (MK Surveys) is available for the site and adjacent floodplain. The survey can be found in **Appendix B**. The survey indicates that land levels peak in the north-western corner are typically between 66.1 - 65.5m AOD, decreasing gradually across the site to the south-east corner to a lowest recorded level of 63.3m AOD excluding the river, ditches and ponds. These levels indicate that the site is very flat with a fall of around 1 in 200 generally across the whole site.

1.8 The Langford Brook is located to the east of the site, flowing in a south westerly direction away from Bicester Village. Generally the brook is 6-8 m wide throughout the whole eastern boundary. A watercourse has been identified in the SFRA to the north-east flowing through Bicester Avenue Retail Park. Upon inspection while the existing culvert remains it appears to have been cut off and no longer in use. Drains to the south of the site still carry water frequently from surface water runoff in the surrounding local area. Further investigation will be carried out to establish the viability and benefits of opening up the culvert.

1.9 Thames Water searches carried out in November 2018 found in **Appendix G** show an existing pumped main that runs from west to east across the site. This will need to be diverted. There appears to be no other drainage assets within the site boundary. The only historical surface water drainage identified are hedgerow field ditches which were created when the fields were first assigned boundaries. These are not identified as watercourses although do occasionally carry water.

The Proposed Development (Catalyst Bicester)

1.10 Catalyst Bicester is outlined in the Cherwell Local development plan, named as Bicester 10 & Bicester Gateway, to provide employment for up to 3,500 people. This will be a significant increase in potential occupants in contrast to the existing 20 people work force on the chicken farm. Future operational hours will generally be longer than existing business hours on the farm. In order to facilitate this risk in both the short and long term, this assessment is carried out assuming that the future site will be fully occupied.

1.11 The masterplan layout proposals were prepared by Cornish Architects in October 2018. After pre-application meetings with Cherwell in March 2019 multiple options were submitted in a Hybrid application. Later in 2019 preference was expressed on a particular scheme which can be found in **Appendix A**. An artist impression of what the proposed site will look like is shown in Figure 1.2. In early 2020 Cherwell planning authority have indicated that 'Tech Scheme 8' is the most likely scheme to be given approval, therefore this FRA is based on the site Masterplan in this scheme.

1.12 The proposed new business park, Catalyst Bicester, is to comprise of up to 13 units of B1 employment based buildings, which can be adjusted based on end user demand with associated infrastructure, car parking and service yards. A new roundabout is to be formed as part of a S278 agreement to provide better access. In addition the proposals include allocation for Class D2 health and recreational facilities with its own separate entrance and parking facilities. Landscaped public access areas are proposed within the allocation to enhance the amenity of the development. The lower fields near the river will become an extension of the existing wetland wildlife areas, providing valuable habitats for plants and animals. The development is expected to have a design life of at least 75 years.

Figure 1.2 – Artist impression of Catalyst Bicester development

2.0 FLOOD RISK PLANNING POLICY AND GUIDANCE

National Planning Policy Framework (NPPF)

2.1 In line with National Planning Policy Framework (NPPF) this FRA will adopt conditions 155 – 165 specific to Planning and Flood Risk. NPPF sets strict rules to protect people and property from flooding which all local planning authorities are expected to follow.

2.2 In plan-making, local planning authorities apply a sequential approach to site selection so that development is, as far as reasonably possible, located where the risk of flooding (from all sources) is lowest, taking account of climate change and the vulnerability of future uses to flood risk. In plan-making this involves applying the 'Sequential Test' to Local Plans and, if needed, the 'Exception Test' to Local Plans.

2.3 The NPPF states that 'inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk, but where development is necessary, making it safe without increasing flood risk elsewhere'. The aim of the Sequential Test is to steer new developments to areas of the lowest probability of flooding. If this cannot be achieved the exception test is then required if indicated by the conditions specified in NPPF.

2.4 Where the development needs to be in locations where there is a risk of flooding as alternative sites are not available, local planning authorities and developers ensure development is appropriately flood resilient and safe for its users for the development's lifetime, not increasing flood risk overall.

2.5 Local planning authorities and developers should seek flood risk management opportunities (e.g. safeguarding land), and to reduce the causes and impacts of flooding (e.g. through the use of sustainable drainage systems in developments).

Environment Agency Flood Zones

2.6 The Flood Zone Map for Planning has been prepared by the Environment Agency. This identifies areas potentially at risk of flooding from fluvial or tidal sources. Mapping reproduced using the Environment Agency Flood Zone data under special licence is included as Figure 2.1.

2.7 The Environment Agency Flood Zone mapping shows Catalyst Bicester to be located within Flood Zones 1, 2 and 3. The NPPF defines Flood Zones 1 as land assessed as having a less than 1 in 1000-year probability of flooding (Low Probability). Zone 2 is described as having between 1 in 100-year and a 1 in 1000-year probability of river flooding respectively (Medium Probability). Flood Zone 3 is defined as land assessed as having a 1 in 100-year or greater annual probability of river flooding respectively (High Probability)

2.8 In further assessment of Flood Zone 3 the Environment Agency splits the Flood Zone 3 into sub-categories Flood Zone "3a" and "3b". These sub-categories are described as; Flood Zone 3a, land assessed as having 1 in 100-year or greater annual probability of flooding. Flood Zone 3b, "The functional floodplain", is defined as land assessed as having a 1 in 20-year or greater annual probability. This serves as starting point for areas which flood water is stored regularly.

2.9 It is believed that the built elements of Catalyst Bicester are to be located in Flood Zone 3a. One of the key characteristics of a functional floodplain is its ability to regularly fill during times of flooding. As flooding at the 1 in 20-year event is predicted to be very shallow, at less than 150mm in the building footprint, regular flood storage capacity would be very limited.

- In December 2019 the EA removed objection 1 to the development being located within Flood Zone 3b.

2.10 To assess if the development is appropriate NPPF provides Table 2 of the Planning Practice Guidance classifying land use. Under these classifications the proposed development uses of Class B1 offices, research, high tech industries or storage/distribution combined with Class D2 leisure and racquet Club, in addition to, essential roads, intersections, drainage and services infrastructure the development is considered to be 'Less Vulnerable' overall**.**

2.11 NPPF Table 3 indicates developments that are 'Less Vulnerable' are appropriate within Flood Zones 1, 2 and 3a. The wetland wildlife area can be classified as Water compatible which is described as appropriate in all Flood Zones, including 3b. It is therefore assessed that the whole of the development is appropriate.

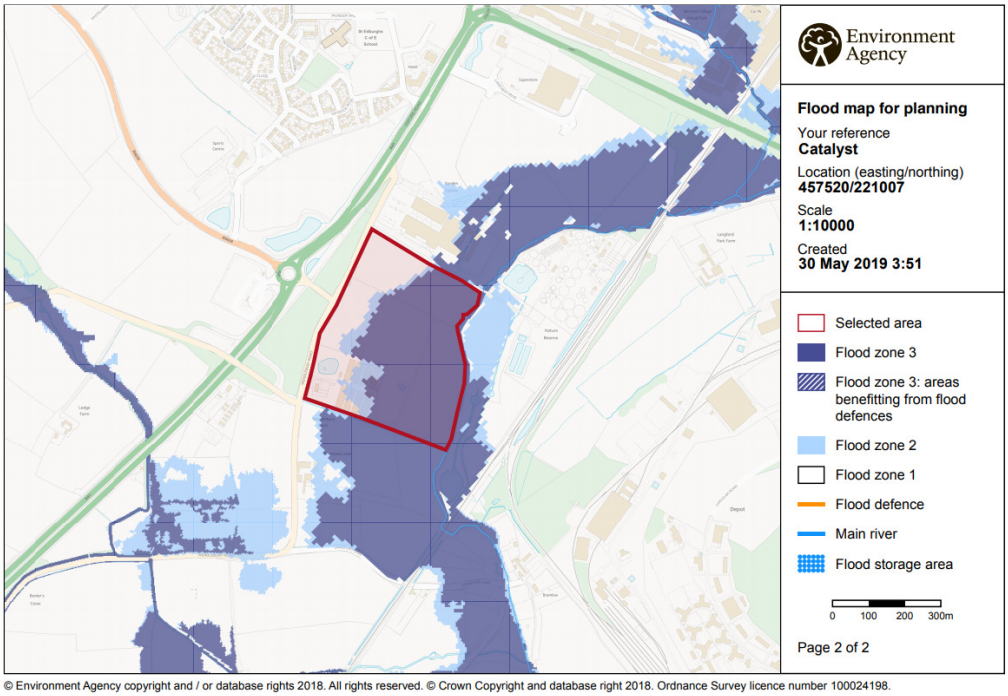

Figure 2.1 – Environment Agency Flood Map for Planning (Rivers & Sea)

Cherwell District Council Planning Policy

Sequential and Exception Test

2.12 The Cherwell Local Development Plan (LDP) 2011-2031 Part 1 was adopted in July 2015 and re-adopted in December 2016. The site is allocated in the LDP under policy Bicester Gateway and Bicester 10 for employment use. The sequential test for this development is considered to be passed. Justification is provided in Cherwell District Local Plan.

2.13 The Sequential Test and Exception Test strategic sites' document was originally published in August 2012, with the 2nd Addendum Published in October 2014. This document, part of the local plan development, mentions the proposed development site as allocated for employment. It is therefore justified that the Exception test is not required for the Proposed Development as 'More Vulnerable' uses are not proposed on the site, in line with local planning policy.

Cherwell Local Plan Guidance (Bicester 10: Bicester Gateway)

2.14 Policy Bicester 10: Bicester Gateway sets out the following employment and infrastructure needs. Those that are relevant to this FRA include:

a. Creating open spaces, planting and strong landscape supporting SuDS.

b. Consideration of the Strategic Flood Risk Assessment for this site including all sources of flooding applicable to the site.

c. Floodplain land in the eastern parts of the site to be used for informal recreation, ecological benefit or wildlife enhancement.

d. Development should not encroach within 8m of the watercourse banks.

e. A sequential approach should be followed; where possible, buildings should be located away from areas at high risk of flooding. Where the development is at high risk of flooding, the development should be made safe without measures increasing flood risk elsewhere.

f. Full mitigation of flood risk in compliance with Policy ESD 6. Surface water mitigation in compliance with Policy ESD 7 specifically referring to SFRA.

g. Investigation into opening of culverted watercourse to the east of the site.

h. No built development is to be located in Flood Zone 3b.

2.15 In the conclusions section of this Flood Risk Assessment there will be an evaluation of the proposed development, Catalyst Bicester's, ability to incorporate the criteria listed in policy Bicester 10. These points have been considered by the design team in the conception of the scheme and influenced the formation of the masterplan.

Strategic Flood Risk Assessments

Cherwell Level 1 Strategic Flood Risk Assessment (May 2017)

2.16 In line with the Level 1 FRA, Catalyst Bicester is a potential development site for the Cherwell area in Bicester as shown in Appendix B of the report. Cherwell falls within the larger Thames catchment, which comprises of about 80% of the district.

2.17 In Table 3.1 of the FRA the EA outlined new climate change allowances from March 2016. The development is classified as 'Less Vulnerable' which means Catalyst Bicester falls into the category for Peak River Flow Allowance for the Thames river basin as, 'Central' and 'Higher Central' estimates for climate change. The allowances are proposed at between 25% and 35%. In addition, Peak Rainfall Intensity Allowances should also have a climate change allowances of between 20% and 40% for consideration of surface water drainage design.

2.18 An assessment of historical flooding at the site has been undertaken. Table 4.1 of the FRA identifies a number of historical flood events which have occurred in Bicester. None are thought to have to have flooded the development site. We have been unable to find any evidence of flooding for this site.

Cherwell Level 2 Strategic Flood Risk Assessment (August 2014)

2.19 A more specific Level 2 SFRA was undertaken by URS in August 2014. It listed Site-Specific FRA Guidance which included:

- Should development pressure create a need to develop within 20m of the ordinary watercourses or within the floodplain, a site-specific FRA will be required to be undertaken to quantify the risks associated with these fluvial sources further. Appropriate mitigation measures should be incorporated to enable development within Flood Zone 3 plus climate change floodplain.
- Appropriate minimum floor levels are to be adopted which should be determined in agreement with the EA. Such development should not increase flood risk to surrounding areas through level-for-level flood compensation.
- A consideration of surface water management options will be necessary as part of any site specific FRA to quantify the volumes of surface water runoff to be discharged (subject to consultation with the LLFA and/or EA,) and the suitability of the SuDS techniques to be incorporated and to be justified.
- An agreement in principle from TW that foul drainage from the site will be accepted into their network should be obtained as part of planning application.
- A site-specific FRA should consider the likelihood and impact of groundwater emergence, define risk of groundwater flooding and SuDS suitability.
- A site-specific FRA should demonstrate suitable provision for dry site access and egress, taking into account requirements of Cherwell emergency plan.

Environment Agency Guidance

2.20 The Environment Agency provided Bailey Johnson Hayes with Product 4 information in January 2018. Following the consultee response from the EA in reference to the FRA submitted for planning in August 2019, additional flood points within the Product 4 information were provided in November 2019. A full copy of the data received from the EA is include in **Appendix C** which includes:

i. Flood map for planning;
ii. Flood defence information;
iii. Flood map based on Catalyst Bicester Site;
iv. Modelled floodplain flows & levels (2010 model based on 20% CC);
v. Historical Flood data information;
vi. Hazard Flood map;
vii. Thames Area Climate Change Allowances January 2016.

2.21 In summary, the Environment Agency information received to date and current guidelines confirm the following:

- The approach taken by Bailey Johnson Hayes to define the flood events for the 1 in 20-year (5% AEP), 1 in 100-year (1% AEP) and 1 in 1000-year (0.1% AEP) year using the EA's flood levels against topographic data is acceptable.

- As the development is within Flood Zone 3, Hydraulic modelling is required to, consider how a range of flooding events (including extreme events) will affect people and property. The site-specific FRA must take the impacts of climate change into account. In response, the 100 year + 35% climate change event was carried out by JBA in January 2020 and can be found in **Appendix F.**

- The Design Flood Event (DFE) for the Proposed Development is the 100-year + 35% event modelled by the JBA in between 64.04 and 64.19m AOD. It is now agreed that a maximum flood level of 64.19m AOD is acceptable.

- A Sequential Approach has been taken to locating development on site. The leisure centre which will see longer working hours then the rest of the development has been located in Flood Zone 1 in order to mitigate risk.

- Minimum finished floor levels should be set at or above the DFE level plus 300mm freeboard, i.e. the 1 in 100 year + 35% change plus freeboard. Therefore, finished floor levels should be set at 64.49m AOD

- Ground raising within the 1 in 100 year + 35% floodplain is acceptable provided level-for-level compensation is provided up to a minimum of 1 in 100 year + 35% climate change flood extent. In order to provide betterment, Bailey Johnson Hayes have provided a scheme up to the 1000-year event which has been agreed by Cherwell Council, Oxford Flood Authority and the Environment Agency.

3.0 CURRENT SOURCES OF FLOOD RISK

3.1 The table below identifies the potential sources of flood risk to the site, and the impacts which the development could have in the wider catchment prior to mitigation. These are discussed in greater detail in the forthcoming section. The mitigation measures proposed to address flood risk issues and ensure the development is appropriate for its location are discussed within **Section 4.0**.

Table 3.1 – Pre-Mitigation Sources of Flood Risk

Flood Source	Potential Risk				Description
	High	Medium	Low	None	
Fluvial/River	X				Located within River Flood Zone's 1, 2, 3a & 3b
Canals				X	None Present.
Groundwater			X		No recorded history of Groundwater flooding.
Reservoirs and waterbody's				X	The site is outside the zone of risk of reservoir failure.
Sewers			X		Existing Pumped Main to be diverted to low risk area.
Surface Water Runoff / Flows			X		Levels locally are very flat, exceedance runoff unlikely
Effect of development on wider catchment			X		Increase in the amount of impermeable surfaces such as roofs and yards

Fluvial Flood Risk (River/Watercourses)

Main River – Langford Brook

3.2 The Langford Brook lies on the eastern Catalyst Bicester boundary. Bicester Town Brook connects into the Langford Brook approximately 800m north-east. The Langford Brook generally flows in a south-westerly direction. Environment Agency mapping indicates that predicted flooding is generally constrained to areas directly adjacent to the river in Bicester. Locally in south Bicester, predicted flooding becomes more wide spread into flatter, lower laying, Greenfield zones.

3.3 On the other side of the Langford Brook, opposite Catalyst Bicester is an existing wetland nature reserve on the site of sewage treatment works. Historically this site has been better protected from flooding due to construction of higher embankments to the river banks. This was to prevent flood water mobilising potential contamination from existing sewage treatment works.

3.4 The data available from the EA, Cherwell District Council and Oxfordshire Flood Department indicate the site does not have any history of fluvial flooding.

Minor Watercourses

3.5 A significant watercourse is located on the southern boundary of the site. This has been labelled as the 'Promised Land Farm Watercourse' on Figure 3.1. This drain collects water from the surrounding land adjacent to Wendlebury Road, such as the new development at Bicester Gateway, Wendlebury Road and Agricultural fields in the local vicinity.

3.6 The flow path runs in a south-westerly direction from the garden centre running parallel to Wendlebury road within a small ditch. Here it collects runoff locally before heading under Wendlebury Road via an existing culvert. Finally it heads south-easterly direction adjacent to the chicken farm and fields before discharging into the Langford Brook. These flows may be disrupted with new highway works.

Figure 3.1 – Location of Fluvial Rivers and Other Watercourses

3.7 The ditch parallel to Wendlebury Road on the western boundary pick up surface water runoff from the road and flow in a south-westerly direction as described previously. These ditches are located on the Bicester Gateway development and do not flow onto the Catalyst Bicester site. Hedgerow ditches 'A' & 'B' which are located within Catalyst Bicester, generally observe small flows, unconnected to surrounding ditches filling in exceedance events to carry standing surface water to the Langford Brook from within the site. The level 2 SFRA indicates there has been no history of flooding from these drains.

3.8 There is a small animal feed pond around 10m in diameter which fills naturally. It was observed during site inspection(s) that only a small amount of water is held in the pond and therefore is has a negligible flood risk. The large 50m diameter pond within the chicken farm boundary appears to of been constructed at the same time as the associated chicken farm from historical mapping. It is not connected to local drains, therefore will not pose risk of fluvial flooding and removal would have a negligible effect on flood risk.

Modelled Flood Levels and Flows

3.9 Updated Environment Agency Product 4 data from November 2019 provides multiple floodplain nodes, as shown in Figure 3.2, which have been used to model flood contours for the site as shown in **Appendix D**. These nodes have been derived from the Environment agency model. Interpolation was then used to estimate flood levels and flows in the first instance before more detailed modelling was undertaken by JBA Consulting in January 2020 as shown in **Appendix F**.

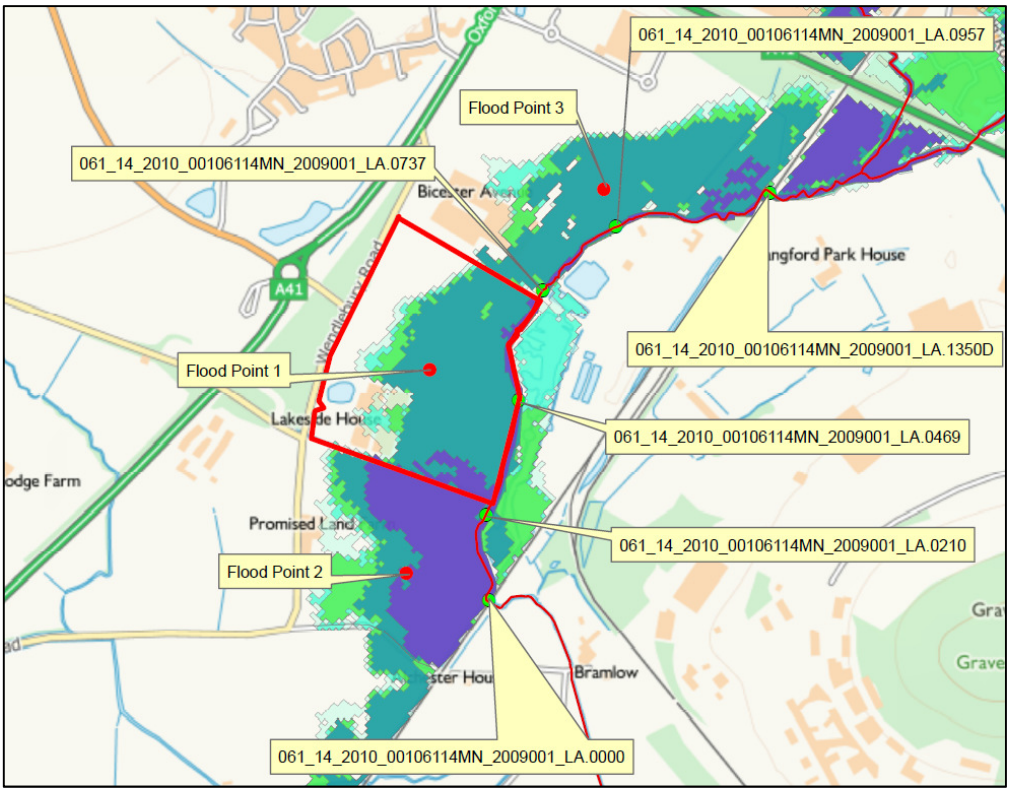

Figure 3.2 – Environment Agency Node Locations Extract

Effect of Different Flood Events including Climate Change

3.10 A review of the EA modelled flood data has been presented in Table 3.2. The results from Flood Points 1 and 2 are very consistent and give a good reliable indication of the expected level of the floodplain across the site at various events. There is a large increase in level of flooding from point 3 located upstream due to a raised land levels. It is unlikely that these levels would reach the Catalyst Bicester site as there are obstructions preventing this.

Table 3.2 – Environment Agency Bicester Model, Modelled Flood Levels

Modelled Flood Levels (m AOD)				
Flood Point	Annual Exceedance Probability (AEP)			
	20–year (5%)	100-year (1%)	100-year + 20%	1000-year (0.1%)
1	63.94	64.07	64.12	64.21
2	63.90	64.03	64.08	64.18
3	64.64	64.73	64.77	64.85

3.11 Further hydraulic modelling, using an updated EA 2010 model, was carried out by JBA to assess the 100-year + 35% event. The 100-year with (+35%) Climate Change peak water levels on site vary between 64.04 and 64.19m AOD. In evaluation of these results they fit within the expected range of results provided by the EA in the first instance.

3.12 In terms of the effect of climate change on the Catalyst Bicester site, the effect can be deemed as low. This is due to the difference in the 100-year event, 100-year +20% and 100-year +35% being between 50 - 150mm. The 300mm freeboard suggested by the EA would have provided enough factor of safety alone. Therefore it can be deemed that the effect of climate change on risk to be acceptable from this development given suitable mitigation implemented as described in section 4.0.

3.13 In terms of the effect of different flooding events, it can be seen from Table 3.2 that the difference in flood levels in the 20-year event and the 1000-year event is very low. This is due to the gentle inclination of the site which would tend to hold large amounts of water at very shallow depths, making this ideal for wildlife wetland areas. There is generally a difference of approximately 250 – 300mm difference in flood levels between a regular flood event and the most extreme flooding event.

3.14 The previous paragraph suggests that the hazard to people can be easily managed. This is because users of the site are less likely to be 'caught out' by fast rising flood waters and therefore advanced warning systems will be more effective as flood waters are unlikely to rise to levels of extreme danger before people / animals can escape.

Groundwater Flood Risk

3.15 Applied Geology carried out a Ground Investigation on behalf of Bailey Johnson Hayes in November 2018. 18 number of 2-3m deep trial pits were opened throughout the site where seepage was recorded in all trial pits. Some moderate inflows were recorded at a couple of the trial pits located in the north-west of the site at depths of 0.8 – 1.2m bgl. The Applied Geology Ground Investigation can be found in **Appendix E**.

3.16 The site does not have any history of groundwater flooding although, borehole logs indicate the water table is relatively shallow (approx. 1m bgl). This groundwater appears to be perched within shallow layers of River Terrance Deposits throughout the site. As a result the construction of foundations will encounter groundwater in some areas around the site. The site has been defined as having poor infiltration which makes it difficult for the movement of groundwater through cohesive layers.

3.17 Overall there is considered to be a low risk posed to Catalyst Bicester from groundwater flooding. During construction of foundations control measures may need to be implemented in order for construction to be carried out successfully.

Flood Risk from Reservoirs & Large Waterbodies

3.18 Reservoir failure flood risk mapping identifies the site to be located outside of the area considered to be affected by nearby reservoir breach.

3.19 Located approximately 3km to the southwest of the site is a medium waterbody near the M40 with an approximate area of 1000m^2. Due to the distance and intervening topography the risk posed is conserved to be low.

Flood Risk from Sewers

3.20 The Thames Water DG5 register identifies no recorded incidents of sewer flooding within the post code areas coving the site around 2000 - 2020. Cherwell CDC are aware of the limited sewer capacity in Bicester, however there have been no sewer flooding incidents. The location of all Thames Water assets can be found in **Appendix G.**

3.21 The development is to be served by a new foul pumping station and surface water drainage network. The existing pumped main is to be relocated with agreement with Thames Water. Bailey Johnson Hayes are in the process of currently obtaining agreement about the location of the diverted pumped main. When the main is moved it will be disconnected to ensure there is no risk of the foul main busting and leaching into groundwater sources.

3.22 Overall there is considered to be a low risk posed to Catalyst Bicester from sewer flooding based on current information. Caution is advised during diversion.

Surface Water Flood Risk

3.23 Risk of flooding from surface water mapping has been assessed by the Environment Agency as shown in Figure 3.3. This shows existing flood potential which could occur when rainwater does not drain away through the normal drainage systems, discharge into rivers or soak into the ground. This can be problematic when water stands on the ground rather than flowing away.

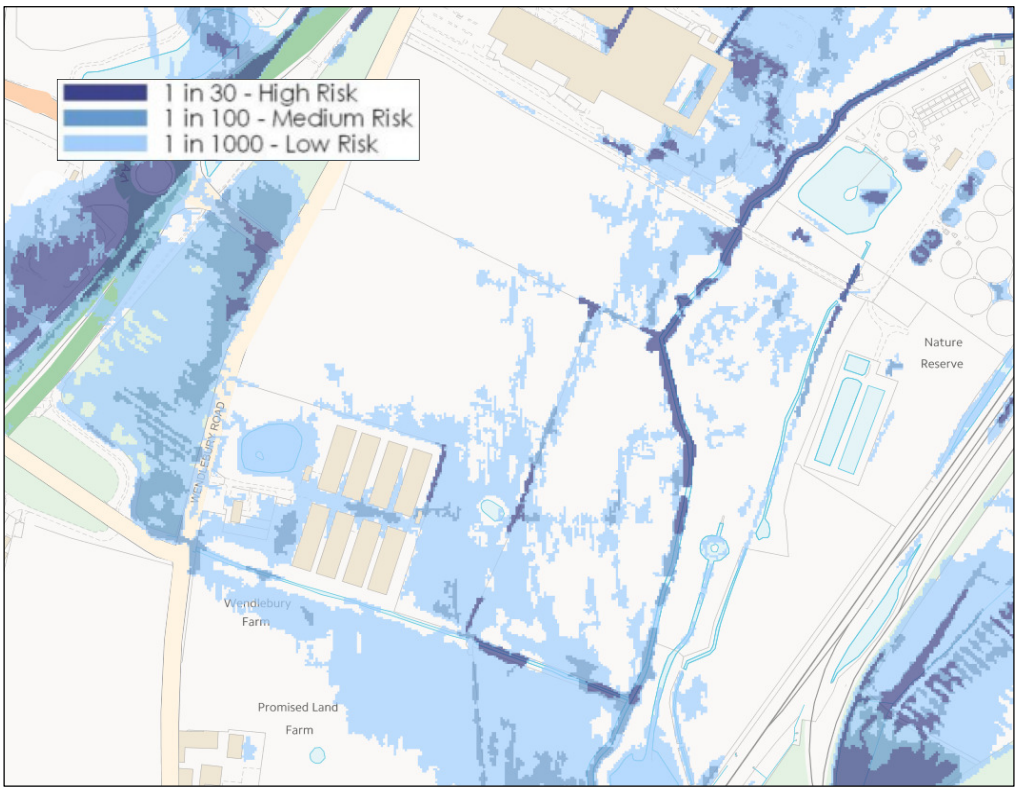

Figure 3.3 – Risk of Flooding from Surface Water Mapping

3.24 There is generally a low flood risk posed to Catalyst Bicester from surface water flooding. Any minor ponding would only occur during extreme storm events. The worst affected areas currently are associated with 'Ditch B' which seems to indicate a medium risk of flooding due to being very flat and shallow.

3.25 There is a high risk of surface water flooding very locally near the Langford Brook and the Promised Farm watercourse which is to be expected as these areas regularly carry a flow of water. The existing chicken farm has a low-medium risk of surface water flooding due to large areas of impervious hardstanding, multiple chicken house roofs and large pond man-made pond in the north west of the site.

3.26 The area in which the new roundabout and highways works are to be carried out is shown in Figure 3.3 to present a high risk of surface water flooding. The proposed works in this area include a new drainage system which will be designed to reduce surface water risk and prevent flooding to the 100-year + 40% rainfall event. The existing culvert and ditches will be confirmed to be of sufficient capacity for discharge from the new surface water system.

3.27 In the north, Bicester Avenue Garden Centre generally has a low probability of surface water flooding in the outside sales area and access road. This area was historically connected to the Catalyst Bicester site via a culvert under the Thames Water Road. On Inspection of this culvert, it appears to be blocked off and no longer in use.

- In line with the Level 2 SFRA and EA advice, it is proposed that this culvert is replaced by a new ditch and connected into the Catalyst Bicester system water for betterment in the wider catchment.

Effect of Development on Wider Catchment

3.28 In the case of Catalyst Bicester SuDS will be adopted where possible to decrease the surface runoff up to the 100-year + 40% exceedance event and attenuate at source. There will be a large amount of roofs constructed which will need to enter a surface water drainage system, preventing over spill into surrounding areas. Any additional impermeable surfaces will be drained appropriately to limit run off to keep risk to a minimum.

3.29 Opening the existing culvert between the Bicester Avenue Garden Centre and Catalyst Bicester will benefit the wider area. Surface water or flood water will be channelled towards the Langford Brook via a new hedgerow ditch. Previously this water was being trapped and not flowing away upstream.

3.30 Landscaping to the eastern side of the site, which in the proposals will remain as wetland for ecological benefit, will pose no increased flood risk as proposed levels are to stay similar.

4.0 FLOOD RISK MITIGATION

4.1 **Section 3.0** has identified the sources of flooding which could potentially pose a risk to the site and the proposed development. **Section 5.0** describes the proposals for the Catalyst Bicester development incorporating recommendations from this section. This section of the FRA sets out the mitigation measures which if incorporated within the final proposed development will reduce risk of flooding to within acceptable levels. Flood mitigation is in accordance with CIRIA C624.

Development Zoning

4.2 Careful planning of the development layout can manage to reduce the need for many other mitigation measures. Looking at the current Masterplan by Cornish Architects in **Appendix A**, Green space zone separation has been provided between the Langford Brook and the built development which covers most of Flood Zone 3b. This sequential approach has located buildings at the safest possible location on this site reducing the risk of flooding significantly.

4.3 There are some landscaped areas designed to encourage public access in Flood Zone 3 approximately 100m away from the Langford Brook. At this distance away from the river only low levels, 0.30 - 0.50m, are predicted to occur in the 1000-year storm. In the 1 in 20-year storm flooding is much more acceptable with only 0.05 – 0.25m which would only pose a risk to highly vulnerable users. With appropriate flood warning systems as described later on in this chapter risk can be mitigated is therefore acceptable.

4.4 The remaining areas of the built development that are located within the floodplain are to be 'Land Raised' as described in the following paragraph. The effect of land raising in the built development and at the new highway intersection will mean that flooding in this area has a probability of less than 1 in 1000 so is acceptable.

Wetlands Wildlife Space

4.5 An outline Wildlife scheme has been proposed in **Appendix K** by Bailey Johnson Hayes. In additional to the initial concept plans the following items should be considered when moving to detailed design:

- Raised footpaths and/or access roads where appropriate to provide safe pedestrian and/or vehicle access to users and those maintaining and constructing the Wildlife Wetland Area above the 1 in 20-year Flood Levels
- Flood evacuation and management plan in Wildlife Wetland Area and pedestrian encouraged landscaping areas across the whole development.
- Protective fences and signs to the medium/high risk zones that warn the public of potential water hazards. These are to be located in appropriate places where visibility can be maintained at all times.

Land Raising

4.5 Typically, finished floor levels are set with a freeboard above the Environment Agency local modelled flood levels. The JBA modelling indicates a maximum 100-year + 35% flood level of 64.19m AOD. It is recommended to raise finished floor levels for the entire multi-unit scheme an additional 300mm above this level to provide suitable mitigation in the event of fluvial flooding, therefore the minimum finished floor levels will be, 64.19m AOD + 0.3m = **64.49m AOD (Min.)**

4.6 The finished external levels of the development should also be set a nominal 150mm above 100-year + 35% event and direct any overland flows away from proposed or existing buildings. While surrounding infrastructure such as roads, footpaths and yards are water compatible it is recommended that ground raising takes place so that the minimum external level is no lower than design flood level, therefore minimum levels are, 64.19m AOD + 0.15m = **64.34m AOD (Min.)**

4.7 The BJH proposed levels are in the order of 64.75 – 65.00 m AOD. All raising of land within the 100-year + 35% floodplain should be compensated using level-for-level approved flood compensation scheme. Bailey Johnson Hayes have proposed this in further paragraphs within this section.

Safe Access and Egress

4.8 Safe access will need to be available into the development for motor vehicles, pedestrians and emergency vehicles at all times. This is shown to be via the new roundabout access and associated highway upgrade to be constructed to the west of the site between Wendlebury Road and Vendee Drive. The new intersection is located within Flood Zone 1 and therefore has less than 1 in 1000 chance of flooding from fluvial sources.

4.9 All drainage systems from the new intersection and road will need to be designed appropriately in order prevent flooding in all events, up until the 1 in 100-year + 40% event. Attenuation swales which outlet into local ditches, eventually discharging into the Langford Brook, have been proposed in order to successfully attenuate extreme event runoff. Therefore risk can be acceptably mitigated.

Pollution Prevention

4.10 As the development is to include car parks, service yards and roads where HGV's spend extended periods of time, the following pollution mitigation methods are proposed. This can be done by draining heavily trafficked areas that are cleansed through various systems such as; petrol interceptors in a piped system, sub-grade layers if using porous paving finishes and filter channels. This will be discussed more in detail later on in the surface water management section.

Flood Compensation

4.11 Level-for-level flood compensation storage works are required where the development proposals result in a loss of volume of the floodplain. It has been decided by Bailey Johnson Hayes to provide compensation storage up to the 1000-year event rather than the 100-year + 35% in order to provide betterment. The current flood compensation details can be found in **Appendix H.**

Loss in Floodplain Capacity

4.12 As part of the proposal, it is intended that the areas highlight in blue in Figure 4.1 are to be raised above the 1000-year flood level, resulting in lost storage volume.

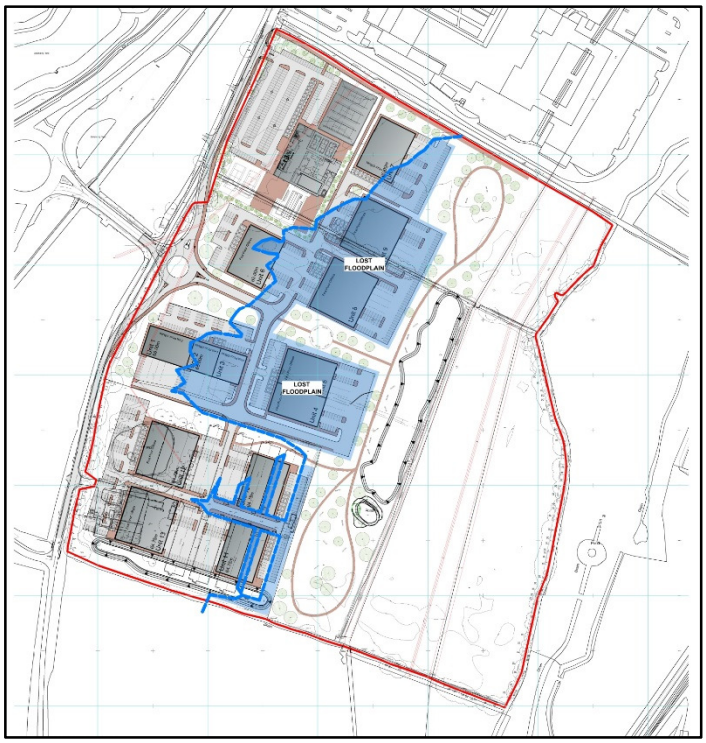

Figure 4.1 – Loss of the 1000-year floodplain

4.13 Using manual estimation techniques, 3D Revit modelling and topographical survey data, a level-for-level volume capacity was derived from the blue areas. Results are shown in table 4.1

Table 4.1 – Floodplain Lost Volumes

Elevation (m AOD)	Volume (m^3)
63.65m	0
63.75m	71
63.85m	409
63.95m	1298
64.05m	2983
64.15m	5612
64.25m	7255
64.35m	7446

4.14 Table 4.1 indicates that approximately 7,446 m^3 of floodplain storage capacity will be lost following the implementation of the proposal. By taking the approach of using the 1000-year event rather than the 100-year + 35% the site is predicted to lose an approximate additional 1,600 m^3.

Available Floodplain Compensation Area

4.15 Figure 4.2 shows areas located inside and outside of the Langford Brook's 1000-year floodplain which are available for floodplain compensation.

Figure 4.2 – Available areas of the flood compensation storage

4.16 To support the proposed development, it is intended to excavate the proposed floodplain compensation area down to between 63.50 – 63.95m AOD as shown in **Appendix H.** As part of the detailed design phase, deeper and wider excavation works may be considered in the wetlands areas, however their associated volumes were not considered in the compensation calculations.

Table 4.2 – Floodplain compensation volumes vs. Floodplain loss volumes

Elevation (m)	Lost Volume (m^3)	Gained Volume (m^3)	Change (+/-)
63.65m	0	0	+0
63.75m	71	81	+10
63.85m	409	491	+82
63.95m	1298	1419	+121
64.05m	2983	3106	+123
64.15m	5612	5741	+129
64.25m	7255	7389	+134
64.35m	7446	7878	+432

4.17 The level-for-level compensation indicates that approximately 7,878 m^3 floodplain capacity can be compensated by the proposed floodplain compensation areas outlined in Figure 4.2 and justified by the calculations in Table 4.2. As the above calculations remain largely based on volume-based calculation, the effect of the proposed FCA on peak water level was modelled by JBA.

4.18 Hydraulic modelling of the proposed development after flood compensation was implemented concluding that; the proposed floodplain compensation scheme completely offsets the impact of the raised development plateaus; the proposal will not generate any detrimental impacts across third-party land. It is therefore recommend that the flood compensation be implemented to successfully mitigate the effects of fluvial flooding at Catalyst Bicester.

Flood Warning

4.15 The majority of new developments are designed so that flood warnings are not necessary part of development design. Even so, for Catalyst Bicester it would be advised for the areas in the southern part of the site, designed for public access, that adequate flood warnings are provided as this area poses danger to most.

4.16 A flood evacuation and management plan will be required for any members of the public using any landscaped land around the Proposed Development. This plan will be required during the detailed design stage to manage the residual risk of flooding on the site posed to both people and vehicles. The plan should consider:

- Signing up to the EA's flood warning service to provide early warning of flood events in the surrounding area;
- Closing of parts of the site predicted to be affected by flooding to prevent people/animals entering the floodwater;
- During construction the Contractor should sign up to Environment Agency's flood warning service and locate stockpiles outside the 1000-year flood extent.
- Methodology to establish how the flood levels are monitored and what/when actions are taken on site.

Management of Potential Groundwater

4.17 The groundwater table is approximately 1m bgl across the site as identified in Section 3.14. In order to protect potential attenuation features it is advised that impermeable membranes be utilised in order to protect from loss of capacity due to rising ground water. This will also prevent potential pollutants from the proposed development leeching into the ground itself.

Management of Surface Water Runoff

4.18 The Surface Water Management system is to be based on CIRIA C753 SuDS Manual as required by Cherwell County Council and Oxfordshire District Council. Infiltration is not recommended from the Ground Investigation soakaway results. Advice is given about the feasibility, appropriateness and management of surface water concepts based on the surface water design and calculations which can be found in **Appendix J.**

4.19 The surface water management system is to be designed to ensure that the level of flood risk from the drainage system is acceptable for the site. All runoff should remain within the designated conveyance and storage areas for the design event (1% AEP + 40%), including an appropriate freeboard allowance. When designing a surface water management system for a very flat site, the following challenges should be considered within the design process:

- Achieving sufficient gradients to drain runoff effectively
- Difficulty in meeting outlet levels to existing watercourses or sewers
- Impacts of downstream water levels on drainage system performance.
- Protecting the surface water system from inundation from fluvial flooding

4.20 On very flat sites, it is often not possible to construct piped drainage systems with sufficient falls to achieve minimum self-cleansing velocities. So using shallow SuDS components such as swales, pervious pavements or high capacity linear drainage channels is an advantage in these situations. Good SuDS design should aim to divide the site into small sub-catchments and provide local combined storage networks.

4.21 To reduce off-site impacts of surface water run-off, attenuation swales have been proposed to control outflow at Greenfield run-off rates. This will ensure that the run off released into the Langford brook will not be increased. Non-return values should be used to ensure that flood water does not enter into attenuation systems located in the floodplain. An increased outflow could create severe flooding impacts downstream at Promised Land Farm. The wetland areas will be drained naturally very similarly to the existing arrangement with some re-grading.

Residual Risk

4.23 There remains residual flood risk to the wildlife areas allocated for wetland use across the eastern boundary of Catalyst Bicester. Approximately 5ha of land will remain within the 1 in 20 year event. In order to mitigate this further, access will be strictly limited in these areas for authorised personal only and those carrying out maintenance works. There is a very small residual flood risk to surface water flooding due to failure of surface water systems. Regular maintenance of systems and overland flows will direct collected water to areas of the development that are at least risk.

5.0 DETAILED DEVELOPMENT PROPOSALS

Design Philosophy

5.1 An approach has been taken by the developer in liaison with Cherwell CDC, Bailey Johnson Hayes and advice from the FRA that enables the site to be sustainable in the long term future and meet the needs of the community. It does this by offering benefits to Cherwell CDC, neighbouring land owners, future occupants of the development and the ever increasing residential population.

5.2 The main ways in which the proposed development achieves this are:

- Proposed Flood Compensation Scheme (FCS) to the 1000-year flood event to create betterment of flood storage volume capacity.
- SuDS used within the proposed development in the form of swales, permeable paving in carparks and underground restricted attenuation as recommend by OCC which also enhances local ecology.
- Strategic landscaping to reduce hazards in areas with public access and reduce risk to acceptable level within the whole development.
- Total of approximately 50,000m^2 for wetland wildlife zoning which enhances and protects the floodplain in the long term.

5.3 The existing/proposed site sections, proposed levels, proposed surface & foul drainage concepts, diverted pumped main concept and proposed wetland landscaping can be found in **Appendix K** of misc. drawings.

Appropriate Development

5.4 Land use has been allocated sensitively as clearly visible on the proposed site sections. Wildlife conservation areas to the east of the site are entirely appropriate for areas subject to the deepest flooding of up to 600 – 700mm in the 100-year + 35% flood event. Ecology in these area will thrive similar to wetlands locally across the river. The main development is classified as less vulnerable and located in the west of the site least susceptible of flooding. To mitigate even small risk the development has been raised well above the design flood level

5.5 Land which will remain as landscaping with paths, benches for public access will be tweaked very slightly so that the footpath levels are at 63.90m. The maximum flooding encountered in this area will be 300mm. >300mm flood levels present a low danger hazard and can be negotiated in times of flooding. The raised development is in close proximity of flood risk areas so means of escape can be easily achieved for most. The development zoning and land raising is considered appropriate mitigation.

Surface Water Drainage Strategy

Existing Drainage Regime

5.6 The site is currently Greenfield open space with no known formal drainage system. There are two small hedgerow drains running between adjoining fields throughout the site and around the perimeter. These will be retained and incorporated into the new surface water scheme where possible. Drainage of surface water runoff occurs via percolation into the ground or through overland flows from saturated and impermeable surfaces which follow the site topography. Site investigations carried out by Applied Geology found the site to be underlain by Alluvium and Clay deposits. Permeability of the ground was found to be low to very low and thus unsuitable for infiltration.

Greenfield Runoff rates

5.8 Pre-development (Greenfield) runoff rates were calculated as follows for a 1 hour storm event, considered to be the critical duration storm event for runoff rate. A summary of the calculated peak runoff rates is shown in Table 5.1 below.

Table 5.1 – Greenfield runoff rates

Return Period	Peak Runoff Rate (l/s)
Qbar	24.04
1 in 1 year	20.43
1 in 30 year	55.29
1 in 100 year	76.69
1 in 100 year (plus climate change)	100

Proposed Drainage Design

5.9 A conceptual design of the surface water drainage system has been produced, which outlines the design criteria, SUDS proposals, flow routes through the site and opportunities for source control and attenuation. This design has been produced following current best practise in relation to SUDS and drainage design. The proposed surface water drainage scheme & plans is found in **Appendix J.**

5.10 The surface water drainage system will ensure that the rate and volume of runoff from the site will not exceed the pre-development (Greenfield) values. There are typically two design storm events which should be considered when designing the SUDS system for managing flows and volumes:

- 1 in 30-year storm event where surface water flows are generally managed below ground and / or in well-defined storage features.
- 1 in 100-year storm event with allowances for future climate change, where runoff should be managed within the extents of development site, ensuring that it cannot affect people or properties either in/out of the development.

Sustainable Drainage Systems

5.11 Sustainable Drainage Systems (SUDS) aim to mimic the natural processes of Greenfield surface water drainage, by allowing water to flow along natural flow routes and reducing the runoff rates and volumes during storm events, while providing some water treatment benefits. SUDS also have the advantage of providing effective Blue and Green Infrastructure, ecology and public amenity benefits when designed and maintained properly.

5.12 The site utilises attenuation swales and below ground drainage networks with flow controls to drain surface water. Infiltration is not considered appropriate for this development due to dense clay type ground conditions. Greenfield runoff rate (GRR) calculated using the Hydrology Report 124 method confirms an existing rate of 20.43 litres/second. The development is to limit discharge to the 1 in 1 year Greenfield discharge to reduce the effect to the surrounding area.

5.13 All surface water drainage is to be designed to the latest EA climate change boundary's set in 2016 as design level of 1 in 100 year + 40% CC Storm. Preliminary storage estimates using the greenfield run-off rates predicts required attenuation storage of approximately 7500 m^3 in 1 in 100 year + 40% CC Storm. The proposed scheme is designed so that no flooding will occur on the Proposed Development up to the 1 in 100 year + 40% CC Storm event.

5.14 The current preliminary surface water drainage proposals allow for the following surface water storage volumes:

1. Swale 1 – Approximately 2000 m^3
2. Swale 2 – Approximately 4500 m^3
3. Subgrade Attenuation - Approximately 1000 m^3 (Permeable Paving)

5.15 Overall preliminary design has tried to utilise SuDS where ever possible. All car parks where feasible have been designed with pervious paving and open graded stone to retain surface water at source. Swale 1 is located within Flood Zone 1 and contributes significantly to the required attenuation storage. Flow control devices have been fitted to ensure that in exceedance events that local watercourses are not overwhelmed.

5.16 The swales will need to be designed with minimum 1 in 3 banks as per Cherwell's CDC planning guidance. This is in order to encourage growth of plants and reduce the risk & danger to those maintaining the swale. The swales will also need to be designed to ensure that groundwater and / or floodwater cannot enter into the swale reducing surface water capacity. To prevent flood water overtopping the swale there will need adequate freeboard to the banks. This freeboard should be of at least 300mm around the whole perimeter of the swale. The swale basin will be protected from flood water seepages in the detailed design stage.

Wildlife Conservation Details

5.17 A concept conservation plan has been developed in **Appendix K** to outline key wildlife wetland features. Constructed Wetlands and SuDS (Sustainable Drainage Systems) are man-made systems which function by mimicking the water treatment properties of natural wetlands. Constructed Wetlands range from simple vegetated pond-based systems up to complex, multistage systems treating concentrated point-source effluent.

5.18 Constructed wetlands provide an ideal solution for treating low to moderate strength effluent such as runoff from fields and offer high ecological value. They also come with the possibility of amenity use (e.g. public access, educational visits) and an ability to retain fine sediments containing nutrients such as phosphorus. When accumulated this sediment can normally be spread on farmland after consultation with the Environment Agency.

5.19 Figure 5.1 shows a cross section of an ideal edge, illustrating the benefits of the various water depths for biodiversity (emerging, floating and submerged plants and associated animal communities).

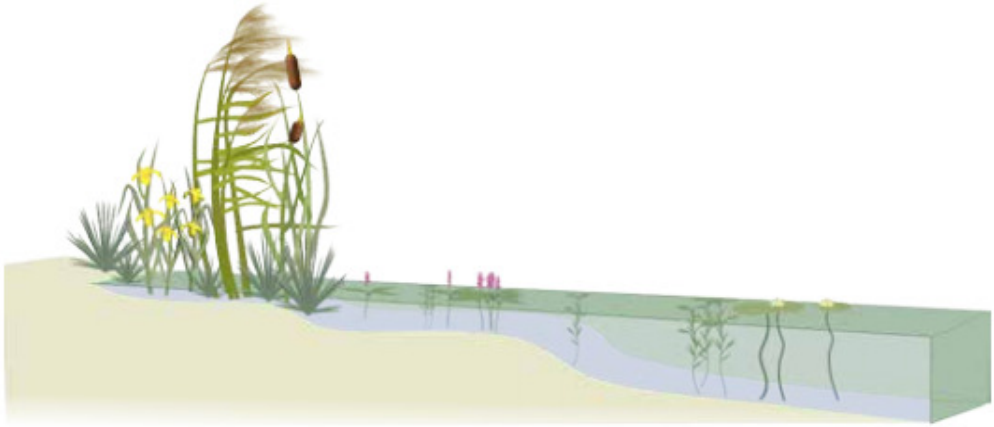

Figure 5.1 – Ideal typical cross-section of wetlands edge.

5.20 In order to prevent any contamination of groundwater or adjacent waterbodies constructed wetlands should either be constructed on an impermeable clay substrate or be lined with an artificial liner. Where constructed wetlands are required to hold water, care must be taken to ensure that they are not constructed near to or below the water table as this could lead to potential groundwater contamination risk. The water table should be no less than 0.5 m below the bottom of the wetland if using an artificial liner and no less than 1 m below the bottom if an in-situ natural liner is used.

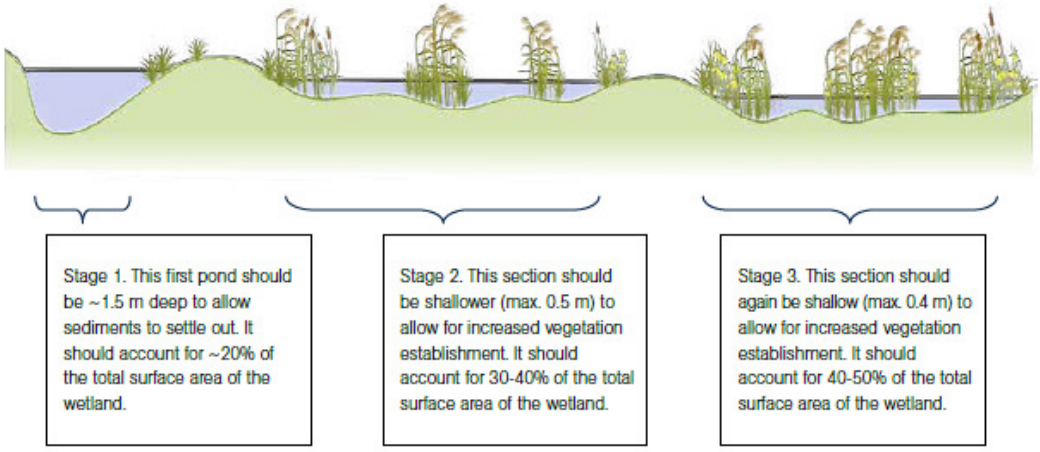

Figure 5.2 – Three-stage constructed wetland.

5.21 Several methods exist for the sizing of wetlands. One of the most widely recognised would be using the three-stage method shown in Figure 5.2. Stage 1 should be 20% of the total wetland area, maximum depth 1.5m. This would include the existing ditches already found on the site. Stage 2 & 3 are shallow vegetated cells with a maximum depth of 0.5m and 0.4 m respectively. These would need to be cut to suit the conditions. Stage 2 should comprise approximately 30-40% and stage 3 approximately 40-50% of the total wetland area.

6.0 CONCLUSIONS AND RECOMMENDATIONS

- Bailey Johnson Hayes was commissioned by Albion Land (Three) Limited to provide Flood Risk Assessment (FRA) for a proposed hybrid development at Catalyst Bicester, Wendlebury Road, Bicester. This FRA report provides information on the nature of flood risk at the site following Government guidance with regards to development and flood risk.
- The proposed development site is located at Catalyst Bicester, approx. 1.0 km outside the centre of Bicester. The existing site is 18.4ha in size and is currently consider Greenfield. The site is bounded by the Langford Brook to the east, Bicester Avenue Garden Centre to the north, Wendlebury Road to the west and Promised Land Farm to the south.
- The proposed development comprises of; 13 Business Units for uses such as offices, research, development and appropriate light industry; health and racquets club with associated parking, tennis courts, air dome, swimming pools and terrace; highway works including new roundabout and access road; creation of a wetland and landscaped areas.
- This FRA follows government guidance on development and flood risk, within the National Planning Policy Framework (NPPF). The NPPF classifies the proposed development as 'Less Vulnerable'. The site lies within the Environment Agency's Flood Zones 1, 2 and 3 and is listed within the local plan for employment, therefore it is considered to of passed the Sequential and Exception tests.
- The proposal encroaches within the 100-year with climate change floodplain. As such, a level-for-level floodplain compensation scheme was designed to ensure that flood water is not displaced elsewhere. Level-for-level floodplain compensation has been achieved up to the 1000-year flood event in order to provide betterment to the wider area.
- JBA was instructed in January 2020 to carry out hydraulic modelling of the development as requested by the EA during planning discussions. JBA concluded that; the proposed floodplain compensation scheme appears to completely offset the impact of the raised development plateaus; the proposed development does not exacerbate flood risk across third-party land; the 100-year with (+35%) Climate Change peak water levels on site vary between 64.04 and 64.19m AOD. This is significantly less than the 1,000-year flood levels (i.e. between 64.19m AOD and 64.46m AOD) used by Bailey Johnson Hayes to design their floodplain compensation scheme.
- As a result, it is considered that the proposed floodplain compensation scheme designed by Bailey Johnson Hayes will be able to offset the impact of the proposal during the 100-year with (+35%) Climate Change fluvial flood scenario and also provide additional floodplain storage capacity during more extreme flood events.
- Building & Access levels have been raised so that they are above the 100-year + 35% level with a 300mm freeboard in order to protect the development from flooding.
- A surface water drainage strategy was designed for the whole development site. The strategy was designed to attenuate surface water runoff for up to the 100-year with climate change storm event down to the 1 in 1-year Greenfield rate. This will discharge to the Langford Brook during peak flow conditions. Provisions for the swales include impervious membranes to protect from rising groundwater and non-return manholes to protect from egress of flood water in all flood events.