8 Water Resources and Flood Risk

8.1 Introduction

8.1.1 This chapter of the ES has been prepared by Bailey Johnson Hayes and assesses the likely significant effects of the Development on water resources, drainage and flood risk.

8.1.2 The chapter is supported by the following technical appendices:

- Appendix 8.1: Site Specific Flood Risk Assessment including flood compensation and surface water drainage schemes (July 2019);
- Appendix 8.2: Applied Geology Ground Investigation Report (November 2018); and,
- Appendix 8.3: Consultation correspondence.

Competence

8.1.3 William Bailey C.Eng., F.I.Struct.E., M.I.C.E. is the principal author of this water resources, drainage and flood risk chapter of the ES. He has over 40 years' experience of carrying out assessments and authoring technical chapters.

8.2 Legislation, Planning Policy and Guidance

8.2.1 The following legislation, national and local planning policy and guidance are of relevance to the assessment of the effects of the Development in relation to water resources and flood risk. A detailed review of policy and guidance is set out in Appendix 8.1.

Legislation Context

8.2.2 The following is a list of the relevant legislation regarding water resources in the UK:

- The Water Environment (Water Framework Directive) Regulations (2017)[1];
- The Water Resources Act (1991) as amended (2009)[2]; and
- The Land Drainage Act (1991) as amended (1994)[3]; and
- The Flood Water Management Act (2010)[4].

Planning Policy Context

National

- National Planning Policy Framework (2019)[5] ('NPPF'); and,
- Planning Practice Guidance[6].

Local

- Cherwell Local Plan 2011 – 2031 Part 1, adopted July 2015 ('CLP 2015')[7];
- Saved policies of the Adopted Cherwell Local Plan, 1996[8];
- Cherwell Local Plan 2011 – 2031 Part 2, Issued Consultation, January 2016[9];
- Cherwell Level 1 and 2 Strategic Flood Risk Assessment[10] (SFRA), 2017; and
- Cherwell Council Surface Water Management Plan Phase 2[11].

Guidance

8.2.4 The following guidance documents have also been referred to:

- Sustainable Drainage Systems, Non-statutory technical standards for SuDs[12];
- CIRIA Guidance Notes; The SuDS Manual C753[13];
- Pollution Prevention for Businesses Guidance 2016[14];
- Flood risk assessments; climate change allowance 2016[15];
- Sewers for Adoption (8th Edition)[16]; and,
- Part H – Building Regulations[17].

8.3 Assessment Methodology

Consultation

8.3.1 The appropriate statutory consultees and private bodies with interest and involvement over flood risk and drainage issues have been identified and approached throughout the scheme design development. These bodies include the Environment Agency (EA), Thames Water Utilities Limited (TWUL), and Oxfordshire County Council (OCC) as the Lead Local Flood Authority in Cherwell District. Their responses (Appendix 8.3) have been collated and their requirements adopted within the Flood Risk Assessment (FRA) included at Appendix 8.1.

8.3.2 A summary of consultation is provided in Table 8.1 below:

Table 8.1: Consultation Response Summary

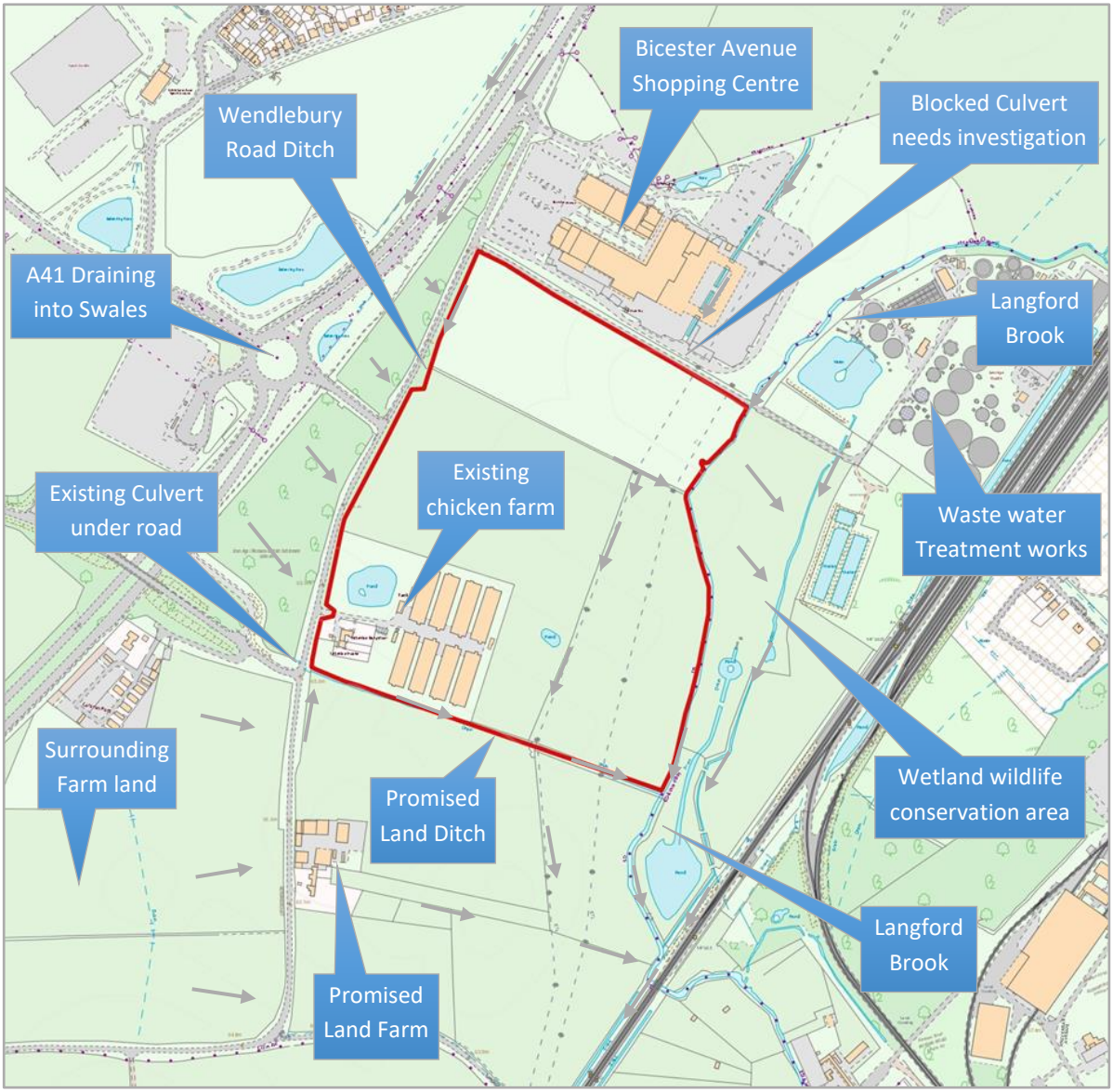
Consultee (Date) and Comment	Response
EA (January 18)	EA have provided Product 4 flood modelling information, historical flood records and flood hazard maps (Appendix 8.1). *"We recommend that you discuss your proposals with the Local Planning Authority at the earliest opportunity. They will be able to advise you on a wide range of planning matters in addition to flood risk."* – EA January 2018
TWUL (July 18)	In reply to BJH's request of details of the location of existing assets running through the proposed development: *"The existing rising main would likely be plastic 100mm diameter and does go to treatment works from pump station in Caravan Park. Hopefully would have a tracer cable to locate it and normally less than 2 metres deep. A S185 application would be needed to divert, unless development can miss the main."* – TWUL July 2018
OCC (January 19)	OCC have commented on Issue 1 of the Site Specific Flood Risk Assessment which is summarised as follows: Flood compensation will need approval from the Environment Agency. Inclusion of Sustainable Drainage Systems (SuDS) are a requirement from the National Planning Policy Framework (NPPF). Surface water management strategy will need to be submitted to support the application. Wherever possible, runoff should be managed at source, the proposed drainage should mimic the existing drainage regime of the site, retaining existing drainage features on the site which should be utilised and enhanced for future use wherever possible. The existing drainage regime needs to be fully understood.

Study Area and Scope

8.3.3 The chapter assesses the potential effects of the proposed Development on the surrounding water environment, water resources infrastructure and the potential effects of the surrounding water environment on the Development. The scope of this assessment includes the Site and relevant local waterbodies and water resource features which could potentially be affected by the Development, including the underlying groundwater, groundwater abstractions and the catchment area for foul water drainage and potable water supply.

8.3.4 The main study area and features considered by the assessment are shown in Figure 8.1.

Figure 8.1: Existing Surface Water Features



Establishing Baseline Conditions

8.3.5 Baseline conditions have been established through a desk study and supplemented by a site visit, undertaken in 2019.

8.3.6 The FRA was undertaken using the EA Flood maps in accordance with the Planning Framework Guidelines. All potential sources of flood risk have been considered by the FRA.

8.3.7 Sewer records have been obtained from TWUL and the existing surface water networks have been reviewed. Consultation has also been undertaken with the EA, the lead Local Flood Authority and CDC to ascertain information on historical flooding and surface water drainage requirements for the Site.

8.3.8 A review of the geo-environmental site investigations has also been undertaken with specific focus on the geotechnical and hydrological data. Applied Geology were appointed by the Applicant to carry out a detailed geo-environmental study in 2018 (included as Appendix E of Appendix 8.1).

8.3.9 Topographical data has been used to determine the landform of the existing Site (Appendix B of Appendix 8.1). This has been used to assist in determining the most appropriate strategy for flood compensation and surface water discharge.

8.3.10 Historical maps have been reviewed to identify any previous water features known to be located in and around the Site and their direction of flow. Ordnance Survey maps and historical mapping have been examined to establish local water features and the present water regimes together with Site and local area inspections.

8.3.11 The study area has been defined using a receptor-led approach looking at the likely hydrological pathways from the Site and the lined receptors. The assessment comprises the impact on the water environment from activities associated with the development of the Site.

Flood Risk

8.3.12 The FRA (Appendix 8.1) covers the more detailed technical aspects relating to hydrology, flood risk and drainage. The FRA assesses the effect of the Development on the local hydraulic regime and risk of flooding.

8.3.13 The FRA has been produced in accordance with NPPF and Planning Practice Guidance and considers the following flood sources: fluvial/tidal, cannels, groundwater, reservoirs and waterbodies; sewers, pluvial runoff and effect of the Development on the wider catchment. The assessment considers the risk of flooding on and off the Site, taking into account the proposed approach to drainage set out in the Surface Water Drainage Strategy and taking into account climate change.

Surface Water Drainage and Water Quality

8.3.14 A review of the topographic survey, TWUL Sewer Asset Plans have been undertaken as part of the FRA to assess the existing drainage system serving the Site, which has informed the surface water drainage designs for the Development.

8.3.15 A surface water drainage scheme has been developed to mitigate surface water flood risk allowing for a 40% increase in rainfall intensity due to climate change estimates. Detailed hydrological and hydraulic modelling of the Langford Brook has not been undertaken as part of the FRA. The drainage scheme has developed in accordance with the principles outlined within the latest technical guidance, with emphasis on the adoption of CIRIA SuDS Manual C753 for the design of sustainable drainage features.

8.3.16 The Ground Investigation (Appendix 8.2) explains that water quality data, taken from the Langford Brook, 45m south east of the Site, indicated a chemical and biological grade of B in 2009. Results are graded from A ('Very Good') to F ('Bad'). The Langford Brook is graded as B and therefore can be described as having good local water quality.

Foul and Potable Water

8.3.17 TWUL Sewer Asset Plans indicate the location of the nearest adopted foul manhole is approximately 500m north of the Site. For the Development to utilise this manhole would require pumping from the centre of the Site. The other option is to pump directly to the foul water treatment centre, similar to the existing pump foul main already running through the Site from the caravan park in the south west. There could be an opportunity to combine the Development foul system and the Caravan Park systems together which will need to be explored in detail.

Identifying Likely Significant Effects

8.3.18 A qualitative assessment of the likely significant effects has been undertaken using professional judgement and experience of similar projects.

Determining Effect Significance

8.3.19 The assessment of likely significant effects as a result of the Development has taken into throughout all stages of Development including; enabling works, construction phases and once the Development is completed and occupied. Receptor sensitivity and magnitude of change criterial is based on professional judgement and includes what is professionally interpreted as being important in defining such thresholds. In addition, the final conclusions as to the significance of any effects also includes a consideration, based on professional judgement, of the efficacy of Scheme Design and Management measures in reducing the magnitude of the effects.

Sensitivity of Receptor

8.3.20 Sensitive receptors have been identified through desk study of the baseline conditions and consultation. The sensitivity of the water environment is determined by the assessment of the baseline environment on and around the Site. Table 8.2 sets out these descriptors.

Table 8.2: Receptor Sensitivity Descriptors

Value (Sensitivity)	Surface Water Receptors
High	Surface watercourses with high sensitivity and quality. Watercourses with national or international designation. Areas which are classified under NFFP as highly vulnerable. With reference to flood risk, these can include essential infrastructure, emergency services and basement dwellings.
Medium	Surface watercourses with very good surface water quality, utilised for abstraction purposes or supporting high biodiversity. Watercourses with high amenity value. Areas which are more vulnerable. With reference to flood risk, these can include hospitals, residential units, educational facilities and waste management sites.

Value (Sensitivity)	Surface Water Receptors
Low	Surface watercourses with good water quality possibly utilised for abstraction. Areas which are less vulnerable. With reference to flood risk, these can include retail, commercial and general industrial units, agricultural/forestry sites and water/sewage treatment plants.
Negligible	Local Land Drain and culverts. Areas which are considered to be water-compatible. With reference to flood risk, these can include flood control infrastructure, docks/marinas, pumping stations and recreational/landscape areas.

Magnitude of Impact

8.3.21 The magnitude of impact descriptors are set out in Table 8.3 below.

Table 8.3: Magnitude of Impact Descriptors

Value (Impact)	Descriptor
High	Substantial increase in discharge rates in excess of the watercourse capacity, major changes to the watercourse hydrology, form, characteristics or chemistry. Significant risk of hydrocarbons and chemicals discharging to watercourse.
Medium	Results in a medium level of change in character such as an increase in the discharge rate but with the channel capacity, major changes to the water course hydrology, form, characteristics or chemistry. Reduction in water quality on or off site within a Class A or B designated system to levels above the relevant guidance.
Low	Results in minor impact on character. Slight to moderate increase in discharge rate. Slight changes to the watercourse hydrology, form, characteristics or chemistry. Includes all short-term effects. Minor risk of hydrocarbons and chemicals discharging to watercourse.
Negligible	No change in the discharge rate, hydrology, characteristics or watercourse form. Discharge to local surface water/land drains but no significant loss in quality.

Assessing Significance

8.3.21 The significance of effects identified is assessed by considering the sensitivity of the receptor along with the predicted magnitude of impact. This is defined in Table 8.4 below.

Table 8.4: Significance of Criteria Matrix

Sensitivity of Receptor	Magnitude of Effect			
	High	Medium	Low	Negligible
High	Major	Moderate	Moderate	Minor
Medium	Moderate	Moderate	Minor	Negligible
Low	Moderate	Minor	Minor	Negligible
Negligible	Minor	Negligible	Negligible	Negligible

8.3.22 There is no absolute guidance on the definitions of what degrees of change fall into each class of magnitude of change. It is generally considered that Major or Moderate effects are classified as 'significant' and may include pollution of surface water bodies, irreversible damage or long-term damage to surface water supported important ecological sites, or a large change to the risk of flooding.

8.3.23 Minor or Negligible effects are generally classified as 'not significant' and may include minor derogation or improvements to surface water infrastructure.

Assumptions and Limitations

8.3.24 The assessment has been based on the assumption that the surface water drainage scheme and flood compensation scheme as set out in the FRA would be implemented. The principles of these strategies are secured through the Development Specification. The assessment also assumes that construction activities will follow relevant good practice guidelines and that the appropriate mitigation would be applied (i.e. Construction Environmental Management Plan (CEMP)).

8.3.25 This assessment has been based on readily-accessible data in the public domain supplemented by data provided by the EA, TWUL and as referenced in the FRA.

8.4 Baseline Conditions

Current Land Use

8.4.1 The Site is located approximately 1.65km south of Bicester Town Centre in Oxfordshire with Oxford approximately 16km to the south west. The Site comprises agricultural land within the Application 1 site with an operational poultry farm on the Application 2 site.

8.4.2 The Site is located on the south-western edge of Bicester, east of Wendlebury Road and the eastern end of Vendee Drive and in close proximity to the A41/Vendee Drive junction. Bicester Avenue Retail Park is to the north; a water course (Langford Brook) and open space to the east, with the railway line beyond; and agricultural land with a farm to the south. Vehicular access is from Wendlebury Road. See Chapter 2: Site and Setting for further details.

8.4.3 The western part of the Site is situated within Flood Zone 2/3, whilst the eastern part is within Flood Zone 1 as shown in Figure 8.2.

Topography

8.4.4 A topographical survey of the Site (Appendix B of the FRA), indicates the Site is broadly level with a slight slope to the east towards Langford Brook. The highest Site elevation is found at the north western corner of the Site at approximately 66.1m Above Ordnance Datum (AOD) and the lowest is in the south eastern corner of the Site at 63.1m AOD.

8.4.5 Due to the gentle falls of approximately 1 in 200 and existing ground conditions (see below), only a small greenfield outflow of 20.43 litres per second (l/sec) for the yearly design event is assessed from the Site. Full calculations for greenfield run-off rates from the undeveloped Site can be found in the FRA.

Geology and Ground Conditions

8.4.6 Published information and ground investigation undertaken at the Site (included at Appendix E of the FRA) indicates that the majority of the Site is underlain by Alluvium at depths of between 0.5m and 1.6m bgl. The Alluvium is generally absent in the north west and south west of the Site, where River Terrace Deposits are shown (depths of between 0.6 and 1.8m beneath the Alluvium).

8.4.7 Solid geology of the Kellaways Formation was encountered below, to depths of between 2.35m and 4.1 m bgl. These comprise interbedded sandstone and siltstone of the Kellaways Sand Member, underlain by mudstone, interbedded with siltstone and sandstone of the Kellaways Clay Member. Kellaways Sand is shown to be absent in the north of the Site. The Kellaways Formation is anticipated to be underlain by limestone to the Cornbrash Formation (see Appendix 8.2 for further details).

8.4.1 A review of historical maps shows that the Site has been in agricultural use since the late 1800's and has no other uses. It is not considered that there is any potential for significant contamination on the Site, as confirmed by the Applied Geology Ground Investigation Report (Appendix 8.2). Due to the limited potential for contamination to be present on the Site, impacts on the water environment from the mobilisation of the contaminants have been scoped out of further assessment within this chapter.

Surface Water Features and Drainage

8.4.2 The nearest surface water features to the Site as shown in Figure 8.1 are:

- The Langford Brook, which is a main river in Bicester, flows in a south westerly direction and forms the eastern boundary of the Site;
- The Bicester Wetland Reserve Local Wildlife Site, owned by TWUL which used to be part of the existing waste treatment centre is situated to the east beyond Langford Brook;
- A drainage ditch in Promised Land Farm, which continually takes flows down to the Langford Brook from surrounding agricultural fields, forms the southern boundary of the Site;
- Wendlebury Road surface water verge ditches, situated along the western Site boundary on Highway Land;
- On site surface water run off ditches, those that flow west to east through the Site from the Wendlebury Road are likely to provide a drainage function for the highway drainage and potentially other offsite land;
- On site ponds (Pond 1 is a small (50m^2) agricultural pond in the western section of the Application 1 site. Pond 2 is associated with the poultry farm on the Application 2 site and is approximately 1,600m^2); and,
- A blocked existing culvert on the northern Site boundary.

Surface Water Quality

8.4.3 The Ground Investigation (Appendix 8.2) explains that Application 1 site has been undeveloped and surface water is likely to be uncontaminated and to be of 'good' quality due to filtration of surface water through the soil. Application 2 site has been developed with

associated hardstanding and surface water drainage systems. It is expected that due to treatment of surface water on site that surface water quality will be satisfactory.

Groundwater

8.4.4 The superficial deposits underlying the Site are a Secondary A Aquifer, The Kellaways Sand Member is a Secondary A Aquifer and the Kellaways Clay Member is listed as unproductive strata. Four groundwater abstraction licences are shown within 1,000m of the Site (Appendix 8.1), with the closest being located on the Application 2 site - for general farming and domestic uses. The Site is not located within a Groundwater Source Protection Zone.

8.4.5 Ground investigation at the Site recorded groundwater as 'seepages' in all trial pits apart from two locations where fast inflows were recorded. Shallow groundwater is therefore expected to be relatively shallow at 1m bgl with flow direction likely to be towards the south east, following the topography towards Langford Brook.

8.4.6 There are no landfills or licensed waste sites within 500m of the Site. Five potentially contaminative industries are located within 250m of the Site, relating to electricity substations, located 26m and 169m to the north west of the Site boundary, and the TWUL Bicester Sewage Treatment Works located approximately 150m to the north east. No petrol or fuel sites are located within 500m of the Site.

8.4.7 One pollution incident was recorded within 500m of the Site, located 160m to the north east and relates to a microbiological pollutant in 09/02/2002 and was assigned a Category 3 (minor) impact to water.

8.4.8 The Site is located within a Nitrate Vulnerable Zone.

Flood Risk

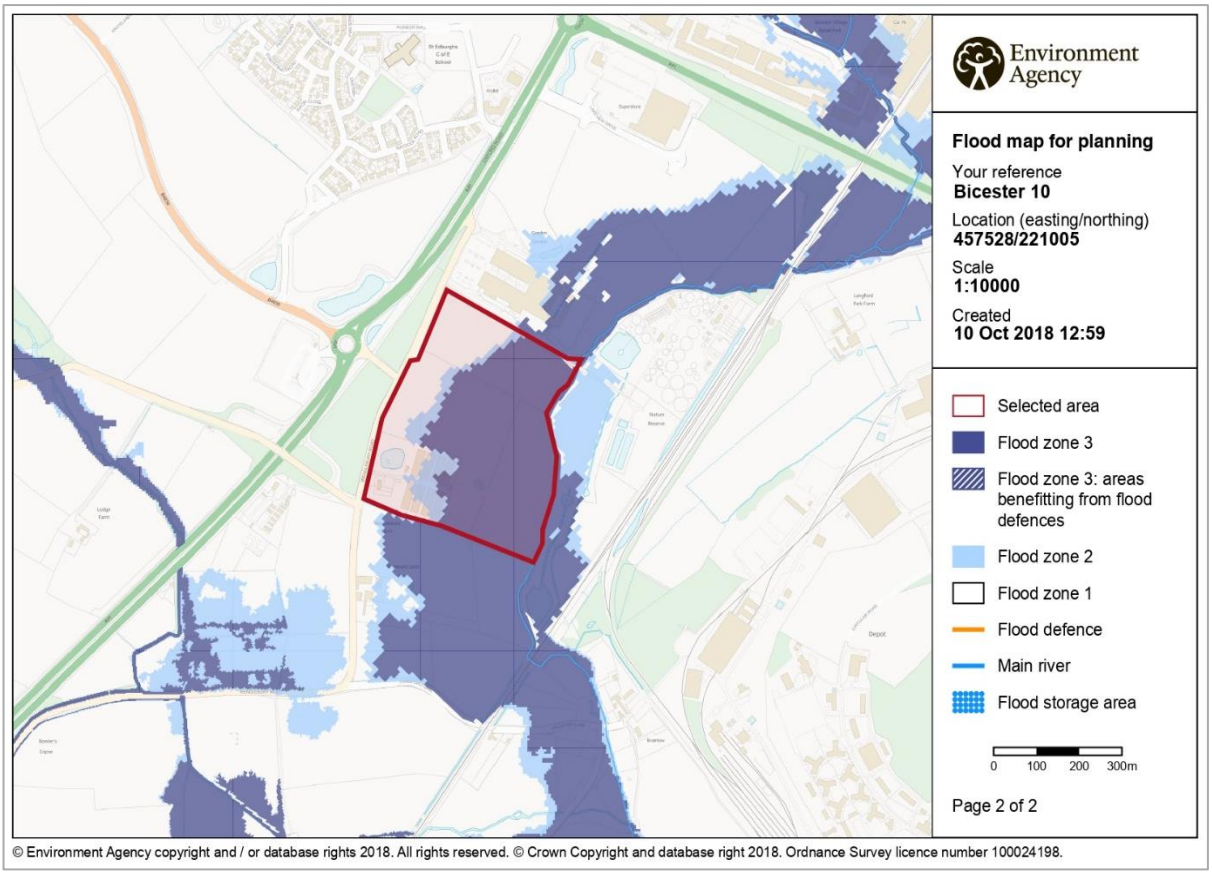
8.4.9 The EA fluvial flood maps indicate that the Site is located in Flood Zones 1, 2 and 3 (Figure 8.2). The Langford Brook forms the eastern boundary of the Site and flows towards the south west. Town Brook connects to Langford Brook approximately 800m to the north east.

8.4.10 EA mapping indicates that predicted flooding is generally constrained to areas adjacent to Langford Brook. Locally in south Bicester, predicted flooding becomes more widespread in Greenfield zones.

8.4.11 The Site does not have a history of fluvial flooding.

8.4.12 Flooding from other sources including tidal, groundwater and other sources have been considered but are not deemed to present a potential flood risk and therefore are not considered further within this assessment (refer to Appendix 8.1 for further information).

Figure 8.2: EA Flood Map for Planning



Existing Drainage

8.4.13 There are no known adopted surface water sewers beneath the Site or area's directly surrounding the development at this current time. There is a pumped foul main that runs from west to east across the Site which will need to be surveyed to plot its exact location.

Designated Sites

8.4.14 The data search confirmed that there are no Special Protection Areas, Special Area Conservation or Ramsar sites within 10km of the Site or any Sites of Special Scientific Interest (SSSIs) within 2km of the Site. As such these are not considered further within the assessment.

8.4.15 There are two Local Wildlife Sites (LWSs) within 2km of the Site: Bicester Wetland Reserve LWS and Graven Hill LWS. Graven Hill LWS is not considered further within this assessment as there are no pathways between the LWS and the development Site.

Summary of Receptors

8.4.16 Table 8.4 below lists the receptors that have been identified as relevant to the assessment of effects of the Development on the water environment:

Table 8.4: Water Environment Receptor Sensitivity

Receptor	Sensitivity (High, Medium or Low)
Waterbodies	
Langford Brook	High
Large pond in the south west corner (Application site 2)	Medium
Promised Land Farm watercourse along southern boundary	Medium
Existing hedgerow ditches	Medium/Low
Small animal feed pond central within Application site 1	Low
Bicester Wetland Reserve LWS (Area of ecological value)	Low
Infrastructure	
Local public water supply and sewerage networks	High
Human	
People and property on and adjacent to the Site, specifically relating to changes in flood risk	High

Future Baseline

8.4.17 The future baseline for the purpose of this assessment is the year 2023 when the proposed Development will be completed and operation. The future baseline is likely to be similar in terms of sensitivity to that of the current baseline with climate change allowances.

8.5 Scheme Design and Management

Construction

8.5.1 A range of environmental mitigation measures will be employed as standard to minimise effects during the enabling, construction phases of the Development, as part of the CEMP, which would be secured by planning condition(s).

8.5.2 The CEMP would set out how construction activities will be undertaken in accordance with good practice guidance, including the EA Guidance for Pollution Prevention (GPP) notes (i.e. GPP13: Vehicle Washing and Cleaning[18] and GPP22: Dealing with Spills[19]) and other good construction guidance such as CIRIA 'Guidance C532 – Control of water pollution from construction sites'.

8.5.3 The construction activity will inevitably involve waste material and therefore careful site management is essential. A detailed Site Waste Management Plan will be prepared and included within the CEMP and construction activities carefully monitored throughout the Site works in order to prevent contamination into any source of water.

8.5.4 All ground conditions will be monitored as work proceeds with all necessary protections in place; any contaminated material will be attended to in agreement with the EA.

8.5.5 All drainage infrastructure work will be arranged such that the extent completed will be ahead of the individual plots such that there will always be adequate storage volumes in place prior to operational use.

8.5.6 Measures will be taken during construction to ensure that silt-ridden and/or contaminated surface water run-off does not directly enter the drainage ditches or Langford Brook. Good construction site management will ensure that surface water is collected by temporary site drainage leading to silt traps before being discharged.

8.5.7 Soil quality will be maximised, and erosion will be minimised by a managed soil stripping programme which will follow EA guidelines of working more than 8m away from the Langford Brook, in order to protect the watercourse from damage.

8.5.8 With regards to the potential risks for contamination of groundwater, the Site is considered to be 'clean", therefore no remediation of soils is proposed.

8.5.9 During periods of heavy rainfall "holding ponds" with restricted outlets will be arranged.

Completed Development

Flood Risk

8.5.10 Parts of the developable areas are at medium and high risk of flooding from Langford Brook located on the eastern boundary and Promised Land Ditch on the southern boundary. Only employment (Use Class B1) and leisure uses (Use Class D2) are proposed which are classified as 'less vulnerable' by NPPF and therefore appropriate for Flood Zones 1, 2 and 3a. Developable areas are located on the eastern part of the Site at least 120m away from the primary source of flood risk, Langford Brook.

8.5.11 The following design measures will be required to mitigate flood risk:

- Ground raising will be undertaken within developable areas to ensure external levels are no lower than 64.15m AOD, the design flood level. This will allow finished floor levels of proposed buildings to be set at a minimum of 150mm above external ground levels to direct overland flows away from buildings;
- Finished floor levels within developable areas will be raised to a minimum of 64.45m AOD. This allows for the 1 in 100 year plus 35% climate change flood level nearest the Site of 64.15m AOD, plus an additional 300mm;
- Access and egress will be available from Flood Zone 1 via the new roundabout and estate roads should be constructed above the design flood level of 64.15m AOD with appropriate flood defence and landscaping freeboard; and
- Public access will not be allowed to the eastern part of the Site (beyond the existing hedgerow to be retained).

Flood Compensation

8.5.12 Where ground levels are elevated to raise the Development out of the floodplain, compensatory floodplain storage within areas that currently lie outside the floodplain must be provided to ensure that the total volume of the floodplain storage is not reduced. Compensatory storage must provide the same volume and be at the same level relative to the flood level as the lost storage to be effective.

8.5.13 An Outline Flood Compensation Scheme is included at Appendix G of the Flood Risk Assessment (FRA) which accompanies Application 1 and Application 2. Details would be developed as part of reserved matters in line with the following principles of the Outline Flood Compensation Scheme.

8.5.14 However, there will be no overall loss of existing floodplain volume storage (calculated to be approx. 43,500 m^3 although this figure will be dependent on the final design of the development). This will be achieved through land re-grading within developable areas and in the north eastern part of the Site outside of the developable area up to 500mm.

8.5.15 The Outline Flood Compensation Scheme is shown in Figure 8.3 and details would be developed with reference to this drawing at reserved matters stage.

8.5.16 An appropriate management and maintenance regime will be in place to ensure the flood compensation scheme continues to function for the design life of the Development.

Surface Water Drainage

8.5.17 In accordance with current good practice and planning policy, the surface water scheme aims to replicate greenfield run-off rates. Storm water from the Development will therefore be retained within the Site and discharged at greenfield run off rates (calculated at 20.43 litres per second). The strategy will limit and control surface water runoff through hierarchal Sustainable Urban Drainage Systems (SuDS) conveyance which may include (but not be limited to) the following:

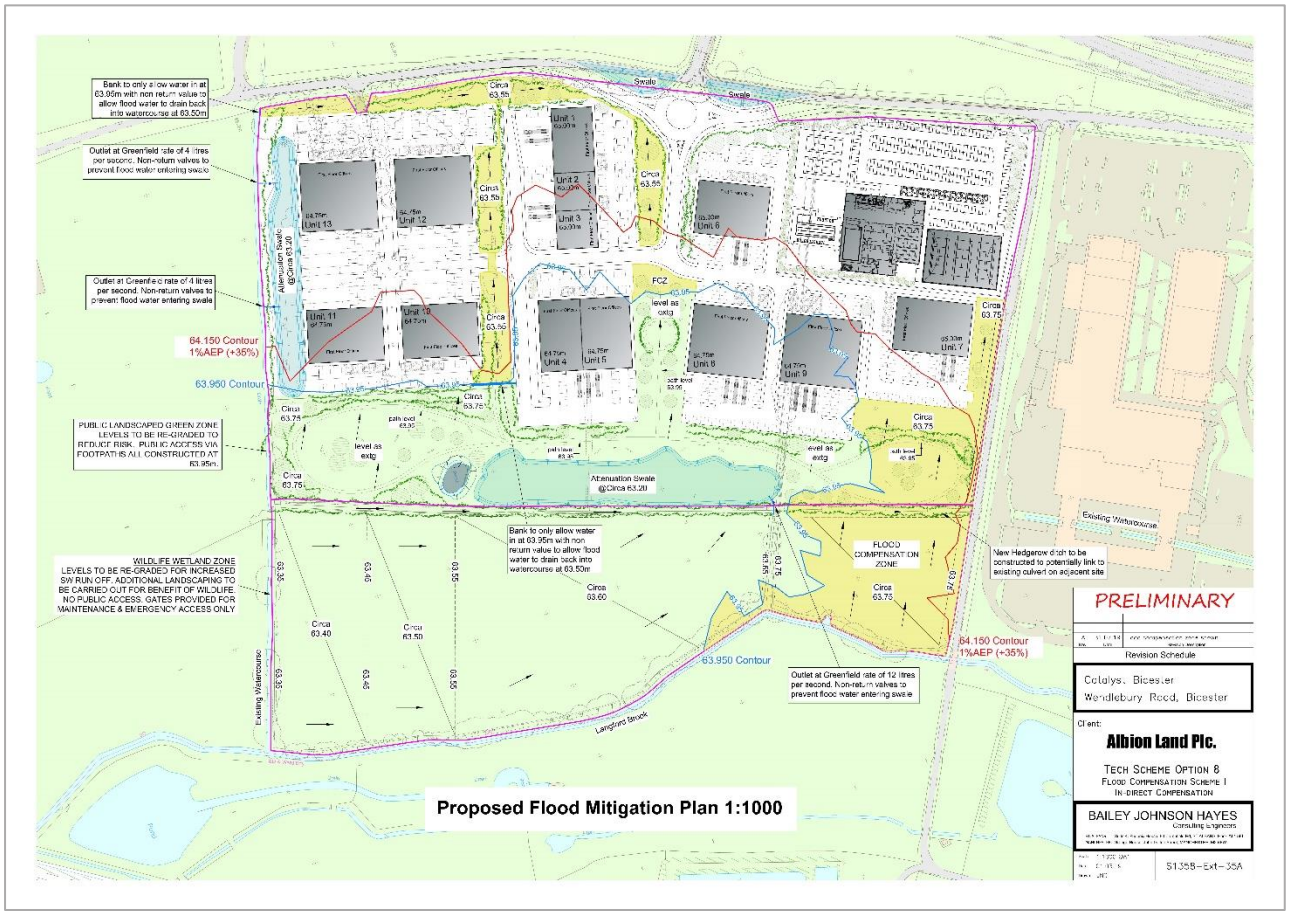
- Permeable block paving car parks;
- Below ground drainage networks with flow controls; and
- Attenuation swales (likely to be located to the east of the developable area of Application 1 and south of Application 2).

8.5.18 All surface water drainage will be designed to 2016 Environment Agency climate change allowances as design level of 1 in 100 year plus 40% climate change storm event. The outline surface water drainage scheme would be developed with reference that included within the FRA (Figure 8.3) which provides for the following surface water storage volumes:

- Swale 1 – Approximately 2,000 m^3;
- Swale 2 – Approximately 4,500 m^3; and,
- Subgrade Attenuation - Approximately 1,200 m^3 (permeable paving).

8.5.19 Details of the surface water drainage scheme would be provided at reserved matters.

Figure 8.3: Preliminary Flood Compensation Scheme Plan (Drawing No. S1358-Ext-35A)



8.6 Construction - Assessment of Effects

8.6.1 This section provides a description of the likely significant effects of construction activities for the Development based on the indicative construction programme of three years from 2020 to 2023 and activities involved.

8.6.2 The construction programme and associated activities involved are necessarily broad at this stage but are likely to comprise large-scale disturbance of soil, including topsoil and subsoil stripping, stockpiling of stripped material, heavy plant and vehicular movements, dewatering and foundation, superstructure and infrastructure constructions. Access for Site construction traffic is expected to be from Wendlebury Road.

Flood Risk

8.6.3 As stated previously, the Site is located within Flood Zones 1, 2 and 3 and therefore raised levels and a flood compensation scheme is required to mitigate against potential flooding. The risk of flooding during construction is considered to be low. Storage of materials should be kept in Flood Zone 1 to minimise the risk of damage during construction.

Construction Workers and Construction Plant

8.6.4 Measures outlined in the Scheme Design and Management section will be taken to protect construction workers and other human receptors from residual risks of excavations flooding and surface water flooding. These include measures such as establishing a flood emergency

and contingency plan as part of the CEMP and implementation of a Construction Traffic Management Plan. Although the potential for a flood to affect workers is low, human receptors are classed as high sensitivity. The magnitude of change on the construction workers and plant is likely to be moderate and the significance of effect is temporary moderate adverse.

Surface Water Drainage and Water Quality

Increased sediment loads

8.6.5 Construction activities are likely to comprise the large-scale disturbance of soil, including topsoil and subsoil stripping, stockpiling of stripped material, heavy plant and vehicular movements, dewatering and foundation, superstructure and infrastructure constructions.

8.6.6 Such construction activities could result in increased surface water release and run-off as a result of the removal of surface vegetation and topsoil, and an increase in areas of hardstanding for the Site compound and temporary car parking. The scouring effects of water would pick up soil particles and transport them in suspension. The magnitude of impact is considered low, the Langford Brook and on Site ditches are classed as high and medium sensitivity, respectively. The potential effects are considered to be a temporary short-term effect of moderate/minor adverse significance.

Accidental leaks of and use of hazardous materials

8.6.7 Leakage and spillage of oils etc., from construction plant, although unlikely, could occur and cause local contamination of ground, groundwater and surfaces of water. In addition, construction fuel tanks could leak or accidentally discharge, potentially causing significant environmental effects to local wildlife and habitats. The magnitude of impact is considered low, the Langford Brook, on Site ditches and Bicester Wetland Reserve are classed as high, medium and low sensitivity, respectively. The potential effects are considered to be a temporary short term effect of moderate/minor adverse significance.

8.6.8 Other pollution sources could be associated with the construction compound where inappropriate handling and storage of construction materials such as solvents, curing agents, paints, cement, and chemicals could result in release of substances and cause contamination of ground water. In the absence of mitigation this could cause significant harm to existing wildlife. The magnitude of impact is considered high, the Bicester Wetland Reserve is classed as low sensitivity. The potential effects are considered to be a temporary short-term effect of moderate adverse significance.

Infrastructure

8.6.9 Throughout the various stages of construction it is estimated that there would be approximately 100 construction personnel present on Site and therefore temporary water supplies and drainage facilities will be provided. Connections to local sewers will be arranged for these temporary usages. These potential effects associated with supply of water and drainage facilities for the construction workforce is considered to be negligible.

Mitigation, Monitoring and Residual Effects

8.6.10 It is considered that the implementation of a CEMP, which will include a Site Waste Management Plan, would ensure risks of contamination are minimised during construction activities. Other good practice measures outlined in Section 8.5 would be sufficient for the

protection of the water environment and local water infrastructure. This will result in residual effects of negligible significance during construction of the Development, requiring no additional mitigation measures.

8.7 Completed Development – Assessment of Effects

Water Quality

8.7.1 There appears to be no significant contamination sources on the Site or in the area close to the boundaries. There are no sensitive groundwater issues therefore contamination from the existing ground is not considered significant. Surface water from potentially contaminative uses within the proposed Development such as service yards, car park areas and internal roads will pass through oil interceptors before outflowing into attenuation swales. The swales SuDS system has natural filtration processes through features such as reedbeds, etc. where silts can be removed before flow controls release water into local water courses at an EA approved water quality.

8.7.2 The outside swimming pool at health and racquet club will be a minor source of contamination due to the chemicals used to clean/maintain the pool. In order to mitigate this, the pool will need to be appropriately protected so that chlorine or other chemicals from the water do not contaminate the surrounding areas. In absence of mitigation, if chemicals were spilled accidentally into areas of landscaping then the impact could cause local contamination of groundwater and reduce surface water quality.

8.7.3 The Development would result in a significant increase in impervious surfaces associated with buildings, service yards and car parking areas compared to the existing situation, and as a result there is potential for an increase in the volume of pollutants to be discharged into the water environment and local water infrastructure to the adjacent ditches/water courses. In the absence of mitigation, surface water discharge from the Development has the potential to contaminate the surface water system as a result of silt laden run-off, spillages and leakage of fuel from vehicles and other sources which, if not adequately managed, could cause local contamination of groundwater and reduce surface water quality.

8.7.4 The magnitude of impact on water quality is considered low. The Langford Brook, local water infrastructure, on Site ditches and Bicester Wetland Reserve are classed as high, high, medium and low sensitivity, respectively. The potential effects on water quality are therefore assessed as being of moderate/minor adverse significance.

Surface Water Drainage and Flood Risk

8.7.5 Development of the Site will lead to a change in the current land surface characteristics by creating large areas of impervious and semi-pervious surfaces associated with car parking and buildings. The main effect will be to increase the volume and rate of surface water run-off compared to that of the existing scenario.

8.7.6 Principles of the surface water drainage scheme are included at the Scheme Design and Management section and details will be developed in line with the Concept Drainage Plan (reference S1358/Ext/34) included in Appendix 8.1. Due to ground conditions across the Site (firm-stiff “Cornbrash”), an infiltration scheme for surface water run-off will not be possible. Overall, a SUDS scheme will be designed to ensure that the run-off is restricted to Greenfield

rates. Greenfield run-off rates have been calculated using accepted methodology and are detailed at paragraph 8.4.5.

8.7.7 Surface water run-off will be managed and run-off rates restricted using on-site swales, sub-grade attenuation and attenuation ponds and is designed to ensure that:

- The Site does not flood from surface water up to and including the design storm event and surface water flooding up to the 1 in 30 year storm event can be safely contained on Site; and,
- Discharges will not exceed the Greenfield Run-Off rates across a range of storm events up to and including the 1 in 100 year storm plus 40% Climate Change.

8.7.8 For the outline components of the applications, details of the surface water drainage scheme would be developed in detail and would be subject to approval at reserved matters stage. The scheme would be designed in line with the principles set out within the Scheme Design and Management section which would ensure that flood risk to the Development and surrounding area associated with surface water drainage would be a negligible effect.

Groundwater

8.7.9 Increases in the impervious and semi-pervious surfaces associated with car parking and buildings would reduce infiltration of water to groundwater and lateral flow. This could have the potential to lower groundwater levels and affect surface water features such as the ponds, ditches and wetlands which are in hydraulic continuity with the groundwater. The Langford Brook on the eastern boundary however, is the main source of groundwater, will still constantly ensure that the ground water table is not lowered significantly due to constant flow, so the effect of the development on groundwater levels will be low.

8.7.10 Furthermore, the Langford Brook has a propensity to rise significantly during flooding events to potential cause groundwater flooding. The flood compensation scheme enables construction of development platforms within the developable areas to ensure that buildings/hardstanding sit above predicted flood levels (see Scheme Design and Management section for further details of levels).

8.7.11 As rainfall will be stored in swales, sub-grade and attenuation ponds that are not designed for soil infiltration, before being discharged to existing water courses at Greenfield flow rates, risks to groundwater will be low due to the poor hydraulic characteristics of the soil. This overall will result in a negligible significance of effect.

Foul Sewer

8.7.12 Upon occupation of the completed Development it is estimated that there could be approximately 1,750 workers. This would result in reasonably large “domestic” type foul flows over an 8-10 hour working day. The closest adopted foul sewer is on the A41, close to Tesco. TWUL have indicated in initial discussions that the A41 sewer has limited spare capacity to serve flows from the additional Developments. The effects of foul water disposal would be much more sustainable if it is pumped directly to the waste treatment centre.

8.7.13 Foul water is expected to outflow to an adopted sewer via large on-site attenuation tanks and pumped mains. The outflow to the public sewer will run over a 24-hour period at a small rate of 20 l/sec to ensure that the sewer and/or Bicester Sewage Treatment Works (STW) are

not overloaded. The magnitude of impact on the foul drainage infrastructure locally will be low, the STW is classed as high sensitivity. This potential effect is considered to be of moderate adverse significance.

Water Demand

8.7.14 The preliminary maximum estimates for the proposed Development water requirements are:

- 100,000 l/day for employment use, based on 30,000m² net internal floor area of B1 Class Use at 50 l/person/day (this is based on UK baseline statistics); and,
- 75,000 l/day for the David Lloyd racquet club (based on UK baseline statistics).

8.7.15 In the longer term it is the duty of TWUL to ensure the supply of adequate water for domestic and employment purposes in accordance with the Water Act 1991. To inform the detailed design stage, TWUL may need to carry out flow and pressure tests for daily demand estimations. This will assess the available capacity in the local supply network and determine whether any additional mains laying is necessary to support the Development. This may be undertaken as part of the detailed design stage if required. These potential effects are considered to be of minor adverse significance.

Mitigation, Monitoring and Residual Effects

Water Quality

8.7.16 All new drainage infrastructure will require regular maintenance in line with an approved maintenance strategy. This will be important to maintain its effectiveness by preventing blockages and build-up of silts.

8.7.17 Surface water run-off from the roofs and external areas will be directed to the below ground gravity network. This water is considered to be generally clean and with limited contamination and may be discharged directly to the new drainage infrastructure and SuDS facilities. Silt is to be prevented from entering the drainage system by the use of trapped gullies, channels with silt or by the use of SuDS. Subject to good management and monitoring to ensure continuous efficient operation, silt will have a negligible residual effect.

8.7.18 The main element of pollution prevention will be the inclusion of appropriately sized oil separators in line with Pollution Prevention for businesses: Use and design of oil separators in surface water drainage systems.

8.7.19 The attenuation swales will be constructed in impermeable ground and to prevent egress of water into the underlying ground.

8.7.20 Following the implementation of the new drainage infrastructure, SuDS features and appropriate oil separators, the residual effect of the surface water discharge on the water quality is considered to be negligible.

Surface Water Drainage and Flood Risk

8.7.21 Surface water run-off would be managed using SUDS, with the general principal to ensure that the surface water discharge rate is no greater than the Greenfield runoff rate. This is in line with the NPPF standard guidance to reduce the flood risk on the Site itself and elsewhere, taking climate change into account.

8.7.22 Due to the increase in impermeable areas from the pre-Development situation, SuDS have been incorporated into the Development and prevention measures will be the initial means of retaining runoff. Infiltration is not a viable option for the Site due to the nature of the existing ground. Therefore, the main form of attenuation will be Attenuation Swales, Tanks and/or Ponds.

8.7.23 The detailed drainage layout will be designed in accordance with the Building Regulations Part H. SuDS guidance will be taken from CIRIA C753.

8.7.24 Class 1 Interceptors will be used for all drains before discharging to local watercourses.

8.7.25 All "high risk" areas will be bunded before discharge via petrol interceptors and discharge to foul sewer, where necessary.

8.7.26 No additional mitigation is therefore proposed and the residual effects on surface water drainage and flood risk is considered to be negligible.

Groundwater

8.7.27 Although natural lateral flow via the groundwater table would be reduced by the introduction of impermeable and semi-permeable surface coverings, maximising the areas of SuDS attenuation devices around the Site reduce the minor changes to groundwater mobility.

8.7.28 Contamination of groundwater from spills and leaks will be prevented by the installation of interceptors, bunding and good site management and maintenance and additional preventative measures.

8.7.29 No additional mitigation is therefore proposed and the residual risk on groundwater flows and levels is considered to be negligible.

Foul Sewer

8.7.30 TWUL would be obligated to accept the foul flows from the Development under the Water Act 1991. TWUL have indicated that capacity is limited to deal with the additional demand from this Development, however it is anticipated that TWUL would ensure that sewerage infrastructure and the adjacent Bicester STW are upgraded to be able to manage predicted flows.

8.7.31 The fowl sewer strategy for the Development has been designed to limit its impact on the STW, and provided TWUL undertake the necessary steps to ensure that there is sufficient treatment capacity to manage the expected foul water discharge from the Development, the effect significance on foul sewer infrastructure is considered to be negligible.

Water Demand

8.7.32 High efficiency water fixtures and fittings within buildings could be incorporated which achieve good quality user experience while minimising water demand, through features such as aeration, and hidden approaches to minimising water wastage such as sensors to shut off supply when facilities are not being used.

8.7.33 Commercial water consumption would be measured using smart meters. Through use of efficient practice fixtures and fittings, including leak detection, it is anticipated that the Development can reduce potable water demand.

8.7.34 On the basis that TWUL will implement improvements to meet the increased water demand of new development within Bicester, and through the application of water use efficiency measures, no adverse impact is predicted on regional water resources resulting in a negligible effect.

8.8 Cumulative Impact

Construction

8.8.1 Cumulative effects of water resources during construction works tend to be associated with the generation of sediments and their release into the drainage network, spillage and leakage of oils and fuels.

8.8.2 The cumulative schemes considered within this assessment for flood risk are those closest (within 100m) to the Site that would have the potential to result in likely significant cumulative effects during construction. Bicester 10 Phase 1 is the only scheme considered as it is located within 100m a Site boundary for the Development. For all other cumulative schemes, they are considered to be of sufficient distance from the Development Site so that cumulative effects would not occur.

8.8.3 Given the sensitive position of the Site the impacts on surface water flow and drainage/flood risk during construction activities would be controlled by CEMPs at the development Site and cumulative schemes. The CEMPs would also manage other potential risks associated with accidental spillages, which could affect water quality, through standard management practices and measures. Consequently, there are not considered to be any potentially significant cumulative effects (i.e. negligible) to water resources, drainage network, or flood risk as a result of construction processes.

Mitigation, Monitoring and Residual Effects

8.8.4 Implementation of the CEMP would reduce the risk of significant cumulative effects with construction of other cumulative schemes during the construction process. As well as minimising the risk of impact, the CEMP would reduce the magnitude of potential impacts so their contribution in terms of cumulative effect would not be significant.

Completed Development

8.8.5 Due to the mitigation measures being undertaken, i.e. Design-in SuDS, there is unlikely to be any cumulative effect on fluvial or groundwater flood risk from the Development in combination with the cumulative schemes.

8.8.6 With regards to drainage, it is anticipated that all local developments will look to reduce site run-off rates through the use of SuDS and also reduce the water consumption of the site(s) from baseline, in line with planning policy. The cumulative effect on surface water drainage would therefore be negligible from the Development in combination with the cumulative schemes.

8.8.7 The capacity of foul water drainage infrastructure is of a high sensitivity and TWUL have indicated that capacity is limited to deal with the additional demand from this Development and likely from other cumulative schemes proposed for development. It is anticipated that TWUL will ensure that sewerage infrastructure and the sewage treatment plant are upgraded to be able to manage predicted flows. Assuming this is carried out, the impact on foul water and sewerage infrastructure is deemed to be non-significant.

Mitigation, Monitoring and Residual Effects

8.8.8 Assuming that TWUL implement upgrades, as necessary, to the foul water and sewerage infrastructure, no residual impacts are expect when considering cumulative effects of the completed development.

8.9 Summary

Table 8.5: Summary of Effects of the Development

Effect	Receptor (Sensitivity)	Geographic Scale	Temporal Scale	Magnitude	Mitigation and Monitoring	Residual Effect
All Development Scenarios (i.e. Scenarios 1 to 4)						
Construction						
Flood Risk - Construction Workers and Construction Plant	Human (High)	Site	Temporary	Moderate	Good site practice in accordance with the CEMP. CEMP to include SWMP. Flood emergency and contingency plan as part of the CEMP.	Negligible
Surface Water Drainage and Water Quality - Increased sediment loads	Waterbodies (High to Low)	Site/Local	Temporary	Low		Negligible
Surface Water Drainage and Water Quality - Accidental leaks of and use of hazardous materials	Waterbodies (High to Low)	Site/Local	Temporary	High/Low		Negligible
Surface Water Drainage and Water Quality - Infrastructure	Infrastructure	Local	Temporary	Negligible		Negligible
Completed Development						
Water Quality	Waterbodies/ Infrastructure (High to Low)	Site/Local	Permanent	Low	New drainage infrastructure to be maintain in line with an approved maintenance strategy, and Class 1 Interceptors to be installed.	Negligible

Effect	Receptor (Sensitivity)	Geographic Scale	Temporal Scale	Magnitude	Mitigation and Monitoring	Residual Effect
Surface Water Drainage and Flood Risk	Waterbodies/ Infrastructure/ Human (High to Low)	Site/Local	Permanent	Minor/Negligible	All surface water flows restricted to Greenfield Levels using SuDS techniques as agreed. Finished floor levels are proposed to be set at a minimum of the 1 in 100 year + 35% climate change + 300mm = 64.45m AOD. Flood compression schemes to be maintained and managed.	Negligible
Groundwater	Waterbodies (High to Low)	Site/Local	Permanent	Low	All surface water flows restricted to Greenfield Levels using SuDS techniques as agreed. New drainage infrastructure to be maintain in line with an approved maintenance strategy, and Class 1 Interceptors to be installed.	Negligible
Foul Sewer	Infrastructure (High)	Site/Local	Permanent	Moderate	Implementation of suitable foul sewer network on Site, to	Negligible

Effect	Receptor (Sensitivity)	Geographic Scale	Temporal Scale	Magnitude	Mitigation and Monitoring	Residual Effect
					be agreed with TWUL.	
Water Demand	Infrastructure (High)	Site/Local	Permanent	Low	Implementation of suitable water network on Site, to be agreed with TWUL and water saving measures to be installed.	Negligible
Cumulative Effects						
None						

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