ENVIRONMENTAL STATEMENT

VOLUME 1

CHAPTER 12 - WATER RESOURCES, FLOOD RISK AND DRAINAGE

12. WATER RESOURCES, FLOOD RISK AND DRAINAGE

12.1. INTRODUCTION

12.1.1. This Chapter reports the outcome of the assessment of likely significant effects arising from the Proposed Development upon water resources, flood risk and drainage. It reviews the potential effects to the Site and its surrounding area from the proposed surface water drainage strategy, water resource requirements and sources of flooding, both posed by the Site and to the Site.

12.1.2. The Chapter describes the assessment methodology, the baseline conditions at the Site and in the surrounding area, any primary and tertiary mitigation adopted for the purposes of the assessment, a summary of the likely significant effects taking into account national legislation, the further mitigation measures required to prevent, reduce or offset any significant negative effects, and the likely residual effects and any required monitoring after these measures have been employed.

12.1.3. This Chapter (and its associated figures and appendices) is intended to be read as part of the wider ES, with particular reference to **Chapter 11: Ground Conditions**. The following appendices for this Chapter are provided in ES Volume II:

- **Appendix 12.1** - Flood Risk Assessment
- **Appendix 12.2** - Below Ground Drainage Strategy
- **Appendix 12.3** - Outline Water Resources Scoping Note.

12.2. LEGISLATION, POLICY AND GUIDANCE

LEGISLATIVE FRAMEWORK

12.2.1. The applicable legislative framework is summarised as follows;

- Water Industry Act 1991 (**Ref 12.1**);
- Land Drainage Act 1991 (**Ref 12.2**);
- Building Regulations Part H (**Ref 12.3**);
- Flood and Water Management Act 2010 (**Ref 12.4**); and
- The Water Act 2014 (**Ref 12.5**).

PLANNING POLICY

Cherwell Local Plan 2011-2031 (Ref 12.6)

The plan is aimed to support and guide developments in the area between 2011-2031. This report has been specifically produced with the following policies in mind;

Policy ESD 3: Sustainable Construction

12.2.2. Policy ESD 3 states "*Cherwell District is in an area of water stress*".

In addition, this policy states "*All new non-residential development will be expected to meet at least BREEAM 'Very Good' with immediate effect, subject to review over the plan period to ensure the target remains relevant. The demonstration of the achievement of this standard should be set out in the Energy Statement. The strategic site allocations identified in this Local Plan are expected to provide contributions to carbon emissions reductions and to wider sustainability*."

Policy ESD 6: Sustainable Flood Risk Management

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

Policy ESD 7: Sustainable Drainage Systems (SuDS)

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

"Where site specific Flood Risk Assessments are required in association with development proposals, they should be used to determine how SuDS can be used on particular sites and to design appropriate systems.

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

Policy ESD 8: Water Resources

12.2.5. This policy states "*The Council will seek to maintain water quality, ensure adequate water resources and promote sustainability in water use*".

12.2.6. In addition, this policy states "*Development will only be permitted where adequate water resources exist, or can be provided without detriment to existing uses. Where appropriate, phasing of development will be used to enable the relevant water infrastructure to be put in place in advance of development commencing*."

12.2.7. In addition, ESD 8 section B.221 states "*Policy ESD 8 will be used to ensure that new development is located in areas where adequate water supply can be provided from existing and potential water supply infrastructure.*"

National Planning Policy Framework (NPPF) (**Ref 12.7**) **and Planning Practice Guidance**

12.2.8. The NPPF (**Ref. 12.7**) was published in February 2019 and is a key part of the reforms to make the planning system less complex and more accessible, to protect the environment and to promote sustainable growth. There is an overarching presumption in favour of sustainable development that should be the basis of every plan and every decision.

12.2.9. The NPPF consolidates all the previous Planning Policy Statements (PPSs) and Planning Policy Guidance Notes (PPGs) into one document. The following paragraphs/policies, among others, are considered relevant to this assessment:

- *Paragraph 155: Requires that "Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk (whether existing or future).*

Where development is necessary in such areas, the development should be made safe for its lifetime without increasing flood risk elsewhere.";

- *Paragraph 158: Explains that "the aim of the Sequential Test is to steer development to areas with the lowest probability of flooding";*
- *Paragraph 163: Explains that "When determining any planning applications, local planning authorities should ensure that flood risk is not increased elsewhere; and*
- *Paragraph 165: Recommends that "major development should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate. The systems used should:*
  - *a) take account of advice from the lead local flood authority;*
  - *b) have appropriate proposed minimum operational standards;*
  - *c) have maintenance arrangements in place to ensure an acceptable standard of operation for the lifetime of the development; and*
  - *d) where possible, provide multifunctional benefits".*

12.2.10. The NPPF should be read alongside other national planning policies and planning practice guidance (PPG), the following are considered relevant to this assessment:

- PPG for Water Supply, Wastewater and Water Quality (2015)
- PPG for Flood Risk and Coastal Change (2014)

Local Planning Policy Requirements

12.2.11. Cherwell District Council produced a Strategic Flood Risk Assessment (SFRA) (**Ref 12.8**) in May 2017 which provides an update on a previous version with new legislative policy and summary of flood risk in Cherwell. The document provides guidelines on use of SuDS and guidance for FRAs and requires consideration of groundwater emergence as part of the decision-making process on the type of SuDS techniques. The list of items to be provided with drainage strategy is included in the document below.

12.2.12. The SFRA required the Drainage Strategy to include:

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

Oxfordshire Flood Risk Management Strategy (Ref 12.9)

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

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

GUIDANCE

The following guidance documents have been used during the preparation of this Chapter;

- The SuDS Manual C753 (**Ref 12.10**);
- In addition, this Chapter has been prepared in accordance with the Government's National Planning Practice Guidance. Chapter on Flood Risk and Coastal Change (**Ref 12.11**);
- Oxfordshire County Council – Local Standards and Guidance for Surface Water Drainage on major Development in Oxfordshire (**Ref 12.12**);
- Future Water – The Government's Water Strategy for England (2008) (**Ref 12.13**); and
- Thames Water: Final Water Resources Management Plan (WRMP) 2015-2040 (**Ref 12.14**).

12.3. CONSULTATION, SCOPE, METHODOLOGY AND SIGNIFICANCE CRITERIA

CONSULTATION UNDERTAKEN TO DATE

12.3.1. **Table 12.1** provides a summary of the consultation activities undertaken in support of the preparation of this Chapter.

Table 12.1 - Summary of Consultation Undertaken to Date

Body / organisation	Individual / stat body / organisation	Meeting dates and other forms of consultation	Summary of outcome of discussions
Oxfordshire County Council	Richard Bennett – Lead Local Flood Authority	Email Correspondence and Pre-App 6 meeting	LLFA would want to see that surface water discharge from the Site is limited to the greenfield run-off rate. The proposed strategy is to mimic the existing drainage regime, using ponds as storage where possible and using the existing site outfall.
Environment Agency	Samuel Pocock – Planning Advisor	Email Correspondence	No comment on the use of groundwater as a water resource.
Bicester Golf Course	Ground Maintenance Staff	Site Walkover	Understanding of existing drainage system as well as current and historic drainage issues.

Body / organisation	Individual / stat body / organisation	Meeting dates and other forms of consultation	Summary of outcome of discussions
Thames Water (TW)	Hemlata Gurung – Developer Services	Pre-Development Enquiry	No comment on the discharge of surface water via proposed outfall as it does not communicate with a Thames Water Sewer. Raised capacity issues with the foul sewer and stated requirement for modelling post planning.
Thames Water (TW)	Developer Services	Consultation started September 2018	Water Supply Availability. Pre-planning Capacity Check Enquiry sent to TW on 29th August 2018. The capacity check enquiry requested a peak flow rate of 11 l/s and an estimated annual consumption of 192,600,000 litres per annum. The response from TW dated 19th September 2018 confirmed that TW existing supply network will have enough capacity to supply the first 50 dwellings of the proposed 500 key hotel and waterpark. A clean water hydraulic modelling study is required to assess TW network capabilities and identify the appropriate upgrades or offsite reinforcement, which will be carried out by Thames Water. Estimated typical duration of modelling, design and construction is 18 months.
Cherwell District Council	James Kirkham - Principal Planning Officer	Email correspondence.	'Outline Water Resources Scoping Note' (rev P02) emailed to CDC on 19th August 2019 by Peter Twemlow of DP9. Document outlined estimated annual water consumption, and proposed mitigation measures to minimise water consumption.
Tyrens	Cherwell District Council appointed consultant	Email correspondence.	In response to the 'Outline Water Resources Scoping Note' (rev P02), pre-application advice dated 30th August 2019 was sent by email from James Kirkham of CDC to Peter Twemlow of DP9 on 6th September 2019. Advice provided was from Tyrens, the *"Council's consultant in this respect."* Tyrens provided the following specific feedback in respect to water consumption: *"Going forward we would like to see the following as part of a planning application:* *• Full details of how the BREEAM water credits will be achieved. We would also recommend consideration of additional measures such as rainwater harvesting and greywater recycling to further reduce water demand in this highly water stressed area."*

SCOPE OF THE ASSESSMENT

12.3.2. An EIA Scoping Report was submitted to Cherwell District Council in June 2019, as presented in **Appendix 2.1**. Further information can be found in **Chapter 2: Approach to the Assessment.**

12.3.3. This section provides an update on the scope of the assessment and updates the evidence base for insignificant effects following further iterative assessment since submission of the EIA Scoping Report in June 2019.

12.3.4. The report has been updated to reflect comments from the LLFA, that state that they would like to see the surface water from the site discharged via the existing site flow paths. From a site visit and walkover with the maintenance staff at the existing golf course, this discharge route has been identified and outlined in the Below Ground Drainage Strategy for the Site (**Appendix 12.2**)

Insignificant Effects

12.3.5. The following effects have been deemed insignificant and as a result, scoped out of this assessment.

12.3.6. The effect of the Proposed Development on water quality and flood risk on the local surface water sewerage system is considered negligible, during both construction and operation. This is due to surface water not being discharged via the public surface water sewerage network.

12.3.7. The effect of the Proposed Development on groundwater from a drainage point of view is considered negligible in the operational phase, as there is no surface water discharge to ground proposed.

ELEMENTS SCOPED INTO THE ASSESSMENT

Potentially Significant Effects

The following are considered potentially significant effects during the construction and operational phases:

Construction Phase

12.3.8. Effects on/of flooding to the following receptors:

- Construction workers; and
- Residents/users of the surrounding area.

12.3.9. Effects of the existing surface water drainage ditch network and outfall in terms of:

- Water quantity; and
- Water quality.

12.3.10. Effects on groundwater in terms of:

- Changes to existing levels; and
- Water quality.

Operation Phase

12.3.11. Effects on/of flooding to the following receptors:

- Residents/users of the surrounding area.

12.3.12. Effects of the existing surface water drainage ditch network in terms of:

- Water quantity; and
- Water quality.

12.3.13. Effects on groundwater in terms of:

- Changes to existing levels; and
- Water quality.

12.3.14. Effects on the local sewerage network – foul water.

12.3.15. Effects on the local mains cold water infrastructure.

EXTENT OF THE STUDY AREA

12.3.16. The study area is defined as generally within a 1km radius of the Site, although a number of issues are considered at a greater distance or at the river catchment level, where necessary. The assessment of effects includes surface water and groundwater quality, surface water and groundwater resources (in terms of water quantity), flooding and water consumption.

12.3.17. Based on current knowledge, the study area is not anticipated to change as the project progresses.

METHOD OF BASELINE DATA COLLATION

Desk Study

12.3.18. A Flood Risk Assessment has been prepared in accordance with the standing advice and requirements of the Environment Agency for Flood Risk Assessments as outlined in the Communities and Local Governments Technical Guidance to the NPPF. The Flood Risk Assessment reviews flood risk across the site and summarises the geological setting.

12.3.19. The assessment:

- Investigates all potential risks of current or future flooding to the Site;
- Considers the impact the Proposed Development may have elsewhere with regards to flooding; and
- Identifies suitable mitigation for any potential risk of flooding.

12.3.20. The Flood Risk Assessment can be seen in **Appendix 12.1**.

12.3.21. A Drainage Strategy has been prepared in accordance with CIRIA C753 The SuDS Manual (**Ref 12.10**) and Building Regulations Part H (**Ref 12.3**). The Strategy aims, where possible, to deal with surface water at its source so that it does not enter the drainage system or is delayed and attenuated before it enters the drainage system. This has been achieved through the use of flow control devices, permeable pavements, detention basins, swales and storage tanks. The Drainage Strategy can be seen in **Appendix 12.2**.

12.3.22. In addition, the following sources of information have been used to obtain baseline information:

- Information from the National River Flow Archive (**Ref 12.18**).
- Information from Natural England Open Data Geoportal (**Ref 12.19**).

Site Visit

12.3.23. Site visits were conducted to the Site and surrounding area on 27th March 2019, 1st May 2019 and 17th July 2019. The purpose of these visits was to gain an understanding of the Site's existing drainage regime and the existing outfalls from the Site.

Surveys

12.3.24. An Unmanned Ariel Vehicle survey was conducted across the Site with the aim of assessing groundwater levels. The results of this have informed the below ground drainage design. The survey results can be seen in Flood Risk Assessment contained in **Appendix 12.1**.

Land Owner Engagement

12.3.25. The existing land owner has provided a water bill which documents the mains water consumption associated with the existing irrigation system that serves the 18 hole golf course.

ASSESSMENT METHODOLOGY

12.3.26. Flooding from various sources is monitored and reported by the Environment Agency and assessed in the Site Specific Flood Risk Assessment in **Appendix 12.1**. Localised flooding is to be reported by site staff and local users during the operational phase and construction workers during the construction phase.

12.3.27. Water quality is to be ensured in the operational phase by designing the surface water drainage system in line with the SuDS Manual (**Ref 12.10**) and Proposed Drainage Strategy in **Appendix 12.2**, ensuring that an adequate treatment train is provided. Where this is not the case, the design will be assessed in line with the withdrawn but still recognised Pollution Prevention Guidance 3: Choosing and using oil separators to prevent pollution.

12.3.28. Long term groundwater monitoring is to be carried out during the construction phase to ensure the groundwater level are maintained at an acceptable level set by the geotechnical engineer and monitored for contaminants.

12.3.29. Thames Water are responsible for managing and maintaining the local sewerage network and are responsible for modelling and fortifying it where required.

12.3.30. The annual mains cold water consumption of the Proposed Development has been estimated using applicable industry guidance documentation, in addition to operational data provided by Great Wolf Resorts obtained from equivalent operational developments across the US, as well as guidance provided by appropriate specialists; this has been documented within the 'Outline Water Resources Scoping Note' provided in **Appendix 12.3**. Annual water consumption will be minimised through the adoption of the mitigation measures documented within the 'Outline Water Resources Scoping Note'.

SIGNIFICANCE CRITERIA

12.3.31. The assessment of potential effects as a result of the Proposed Development has taken into account both the construction and operational phases. The construction phase includes enabling works, earthworks and construction activities as set out in **Chapter 4: The Proposed Development**.

12.3.32. The significance level attributed to each effect has been assessed based on the magnitude of change due to the Proposed Development and the sensitivity of the affected receptor, as well as a number of other factors that are outlined in more detail in **Chapter 2: Approach to the**

Assessment. The sensitivity of the affected receptor is assessed on a scale of high, medium, low and negligible, and the magnitude of change is assessed on a scale of high, medium, low and negligible (as shown in **Chapter 2: Approach to the Assessment**).

EFFECT SIGNIFICANCE

12.3.33. The following terms have been used to define the significance of the effects identified and apply to both beneficial and adverse effects:

- **Major effect**: where the Proposed Development could be expected to have a very noticeable effect (either beneficial or adverse) on receptors; flood risk, water quality, biodiversity, groundwater levels and quality, and water resources.
- **Moderate effect**: where the Proposed Development could be expected to have a noticeable effect (either beneficial or adverse) on receptors; flood risk, water quality, biodiversity, groundwater levels and quality, and water resources.
- **Minor effect**: where the Proposed Development could be expected to result in a small, barely noticeable effect (either beneficial or adverse) on receptors; flood risk, water quality, biodiversity, groundwater levels and quality, and water resources.
- **Negligible**: where no discernible effect is expected as a result of the Proposed Development on receptors, and water resources.

12.3.34. As set out in **Chapter 2: Approach to the Assessment**, effects that are classified as **major or moderate** (either beneficial or adverse) are considered to be **significant**. Effects classified as **minor or negligible** are considered to be **not significant**.

12.4. BASELINE CONDITIONS

12.4.1. Baseline conditions for the Site are detailed in the Flood Risk Assessment in **Appendix 12.1** and Outline Water Resources Scoping Note in **Appendix 12.3**, and summarised below.

FLOODING AND DRAINAGE

12.4.2. The Site is located in Flood Zone 1 as noted on the Environment Agency's Flood Mapping (**Ref 12.15**). Therefore, the Site and the surrounding areas are considered to be at a low risk of flooding from rivers and sea. The Environment Agency's mapping shows that the Site is also at low risk of surface water flooding.

12.4.3. Two ditches dissect the Site from north to south, from a site walkover these have been concluded to be land drains, constructed to manage the groundwater across the Site. Although the Site is considered a greenfield site, it does benefit from an enhanced drainage system. This is assumed to alter the discharge profile from the Site. More details on this can be seen in the Flood Risk Assessment in **Appendix 12.1.**

12.4.4. During site walkovers, no evidence of flow controls or attenuation features were found on the Site.

12.4.5. The Site lies in close proximity to a number of surface water and land drains. These are indicated on Oxfordshire County Council Flood Tool Kit online resources (**Ref 12.16**). The nearest main surface water body is the Gagle Brook, located approximately 500m north-east of the Site at its closest point (see **Figures 1-3** and **1-4** of **Chapter 1: Introduction**).

12.4.6. The Site is at a moderate risk of groundwater flooding as indicated by the Unmanned Areal Vehicle (UAV) Survey conducted across the Site and contained in the Drainage Strategy in **Appendix 12.2.**

UTILITIES

12.4.7. There are no public surface or foul water sewers serving the Site, as shown by the Thames Water Asset Location Search plans, contained in the Drainage Strategy in **Appendix 12.2**.

12.4.8. Private water supplies are within 5km of the Site.

GROUND CONDITIONS

12.4.9. The geology of the Site consists of Cornbrash limestone, overlying Forest Marble, which acts as a partial aquiclude. This is shown on the British Geological Survey's online maps (**Ref 12.17**).

12.4.10. The Site is currently used as a golf course and therefore is at a low risk of contamination from its current land use.

12.4.11. Initial, non-intrusive surveys of the Site indicate that the Site is subject to elevated groundwater levels, especially in the south east of the Site. The Site is located within a High Risk zone for Groundwater Vulnerability. The Environment Agency designates this by determining the vulnerability of groundwater to a pollutant discharged at ground level based on the geological, hydrological, hydrogeological and soil properties of the area. The soils within the area are designated with a High Leaching Potential.

12.4.12. It is known that there are two nearby groundwater wells (approximately 600m north of the Site), Bignell Park and Chesterton Field Farm that may be sensitive to changes in groundwater levels. Furthermore, it is understood that the ponds to the north of the Site are groundwater fed and therefore require protecting.

12.4.13. Further information on ground conditions at the Site and surrounding area is provided in **Chapter 11: Ground Conditions**.

EXISTING SITE WATER DEMAND

12.4.14. The Site is located on land associated with 9 holes of the existing 18 hole golf course. Through consultation with the existing land owner, it has been established that the golf course is currently served by a mains fed irrigation system, served by its own utility company dedicated metered mains cold water supply.

12.4.15. A copy of a water bill provided by the existing land owner (provided by Castle Water) identifies that the irrigation system consumed a total of 3,192,000 litres between 16th April 2019 to 18th September 2019 (i.e. the irrigation season).

12.4.16. As the Proposed Development occupies 9 of the 18 holes, it is assumed that existing irrigation system water consumption will reduce by circa 50%, which equates to a baseline water demand for the land associated with the development of 1,596,000 litres per annum.

FUTURE BASELINE

12.4.17. Should the Proposed Development not proceed, it is assumed that land uses on the Site would remain as they currently are and current routine maintenance of water utilities service sustained; it is considered that any future baseline conditions in relation to hydrology, drainage, flooding and water consumption would remain generally unchanged from the existing situation.

12.4.18. Surface water flooding may increase due to the expected increase in frequency and intensity of extreme rainfall events as a consequence of climate change.

SENSITIVE RECEPTORS

12.4.19. The following are the sensitive receptors which have been assessed:

- Neighbouring properties;
- M40 and A4095;
- Thames Water public sewer;
- Thames Water mains cold water infrastructure network;
- Gagle Brook;
- Cornbrash Formation Secondary A Aquifer;
- Local artesian aquifer in the White Limestone – outlined in **Appendix 12.1**
- Private water abstractions at Bignell Park and Chesterton Field Farm;
- Surface water ditches;
- Great crested newts; and
- Groundwater fed ponds to the north of the Site

12.4.20. All key sensitive receptor locations are shown on **Figures 1-3** and **1-4** of **Chapter 1: Introduction**.

12.5. RELEVANT ELEMENTS OF THE PROPOSED DEVELOPMENT AND ESTABLISHING THE PRE-MITIGATION SCENARIO

CONSTRUCTION PHASE

- The proposed car park levels will be raised across the south-east of the Site, by up to 500mm, to reduce the risk of encountering groundwater during the construction of the car park and limiting the amount of excavation required during construction.
- The use of permeable pavements, swales and ponds will reduce the dig depth required across the Site.

- The Site's existing outfall will be reused to increase the sustainability of proposals and to negate the need for a second pumping station to serve the surface water network. This reduces the amount of heavy civils across the Site and simplifies the construction.
- Construction workers are to be trained in the response required to spillages on site and spill kits are to be located across the construction site.
- These elements form part of the application for planning permission, and must be considered in the pre-mitigation scenario as primary or tertiary mitigation.

OPERATIONAL PHASE

12.5.1. The proposed surface water system has been designed to limit the discharge of surface water from the Site to a rate no greater than QBAR, calculated to be 31.3l/s

12.5.2. The proposed car park levels to the south-east of the Site have been raised by up to 500mm so that the proposed tanked permeable paving system does not interact with the elevated groundwater levels in this area.

12.5.3. A proposed SuDS management plan has been included in the Drainage Strategy (see **Appendix 12.2**), to ensure that all elements of the below ground drainage network are provided with the correct maintenance at acceptable intervals for the duration of their lifetime.

12.5.4. Surface water gully pots that are required across the Site are to be installed with a gap between the rear of the gully grate and the kerb to allow for the passage of great crested newts. Furthermore, an exit method is to be included in the gully pots to allow for any great crested newts that may have been washed into them to escape.

12.5.5. 1.84ha of permeable pavements has been proposed across the Site to provide addition treatment to hydro-carbons that may enter the surface water system from trafficked areas. Open channels also provide treatment to surface water by exposing flows to UV radiation that further breaks down hydro-carbons. Further to this, the use of permeable pavements and swales reduces the need for traditional systems, e.g. gullies and linear channel, that pose a hazard to types of ecology that inhabit the Site, for example the great crested newt.

12.5.6. Below and above ground storage structures have been included across the development and are outlined in the Drainage Strategy, to ensure that excess surface water flows, restricted by the above limited discharge rate are safely attenuated below ground.

12.5.7. Penstocks are to be included in positions along the below ground surface water network to allow maintenance staff to isolate contaminate spillages.

OPERATIONAL PHASE WATER CONSUMPTION

12.5.8. In advance of any design works or the implementation of any water consumption mitigation measures, the Applicant estimated the annual water consumption for the Proposed Development would be 192,600,000 litres per annum. This estimate was based on operational data from equivalent operational Great Wolf Resort developments across the USA, and did not take into account any water consumption mitigation measures.

12.5.9. Annual water consumption would be minimised through the adoption of extensive control measures, as documented within the 'Outline Water Resources Scoping Note' in **Appendix 12.3**, which include:

- Low flow rate showers

- WCs with 4.5l effective flush volume
- Wash hand basin taps with flow rate of 8 l/s
- Water efficient commercial dishwashing equipment
- Water efficient commercial washing machines
- The adoption of regenerative media filter technology in the Waterpark in lieu of industry standard 'deep bed medium rate sand filters', to considerably reduce the amount of water required for the backwash process. The estimated annual water consumption reduction through the adoption of this alternative filter technology is 28,800,000 litres per annum.

12.5.10. In addition to the above mitigation measures, the following additional infrastructure would be provided to assist the operations team with minimising water consumption through management procedures:

- Water sub-meters to water-consuming plant or building areas consuming 10% or more of the building's total water demand, linked to building management system, to facilitate monitoring and raise out-of-limit alarms.
- A leak detection system capable of detecting a major water leak would be installed on the utilities water supplies to detect any major leaks within the building, as well as between the building and the utilities water supplies (i.e. on the underground service pipe from the water meters at the site boundary to the point of entry into the buildings).

12.5.11. In response to pre-planning application feedback advice provided by Cherwell District Council's 'water resources' consultant (i.e. Tyrens), a proprietary surface water recycling system would also be adopted to significantly reduce annual water consumption across the development.

12.5.12. In summary, water would be pumped from the main below ground surface water attenuation tank to serve toilet/WC cisterns throughout the development, via a day tank and appropriate water filtration and water treatment equipment. The adoption of this system would reduce the estimated annual water consumption by a further 13,860,000 litres per annum (i.e. further 9%). This estimate is based on the estimated annual collection volume of the surface water attenuation tank, and represents in excess of 90% of the annual WC flushing requirements for the development.

12.5.13. Taking into account the adoption of the identified water consumption mitigation measures, the developments annual mains cold water consumption has been revaluated using applicable industry guidance documentation, operational data provided by Great Wolf Resorts obtained from equivalent operational developments across the USA, as well as guidance provided by appropriate specialists; this has been documented within the 'Outline Water Resources Scoping Note' provided in **Appendix 12.3**. A summary of the anticipated water consumption associated with each significant element of the development is provided in Table 12-2 below:

Table 12-2 – Estimated Water Consumption of the Proposed Development Post Mitigation Measures

Demise	Estimated Consumption (Litres)
Hotel	168,750 per day
FEC & Conference (excluding Laundry)	15,750 per day
Laundry	154,500 per day
Waterpark	95,000* per day
Total (per day):	**434,000**
Total (per annum):	**155,372,000**
Reduction through adoption of surface water attenuation tank recycling system	-13,860,000 per annum
Total (per day):	**395,285**
Total (per annum):	**141,512,000**

12.5.14. In order to address the pre-planning application feedback from Tyrens requesting "full details of how the BREEAM water credits will be achieved", a copy of the BREEAM Wat 01 is provided within the Outline Water Resources Scoping Note' provided in **Appendix 12.3**. This calculator documents that a minimum of 3 no. credits are anticipated for BREEAM credit reference Wat 01: Water Consumption.

12.6. ASSESSMENT OF EFFECTS, MITIGATION AND RESIDUAL EFFECTS

CONSTRUCTION PHASE

Element of topic under consideration – Impact on Fluvial and Pluvial Flood Risk on Construction Workers	As the Site is underlain by an artesian aquifer and excavations are required across the Site, there is a risk of inundation due to construction activities penetrating the aquifer. The construction works of the Proposed Development are likely to benefit from an enhanced drainage system also, therefore it is unlikely that the flood risk from the Site will be increased due to construction activities. Site investigations carried out prior to construction will map the aquifer and the depth of the Aquiclude above it. There is a risk of injury to construction workers due to possible inundation of the site from the artesian aquafer. The sensitivity of construction workers are medium, and the magnitude of change prior to mitigation, is considered to be low. Therefore, there is likely to be a direct, temporary, short-term **minor adverse** effect on construction workers (**not significant**) prior to the implementation of mitigation measures.

Secondary Mitigation	As discussed in Chapter 4: The Proposed Development, a Construction Environmental Management Plan ('CEMP') will be adopted during this stage of development. These plans would include local flood prevention measures, in line with best practice and policy. It is envisaged that temporary drainage systems will be incorporated to manage the surface water and foul water generated on-site, until the drainage strategy for the Proposed Development is implemented. In addition, groundwater would be managed during the construction of the basement. Further investigations, including a piling method risk assessment, would be undertaken by the structural engineer to understand effects on the ground conditions (including hydrogeology).
Residual effects and monitoring	The sensitivity of construction worker is medium, and the magnitude of change, following mitigation, is negligible. Therefore, there is likely to be a **negligible** residual effect on construction workers (**not significant**) following the implementation of mitigation measures.

Element of topic under consideration – Impact on Fluvial and Pluvial Flood Risk on the Public and Local Users	Failure of the temporary site drainage system, during construction, could lead to overland flow and inundation of local residents downstream of the development. The proposed drainage strategy offers an increased level of attenuation when compared with the existing site drainage, and also manages over land flows in line with the existing site drainage regime. The sensitivity of the local residents and user groups is high, and the magnitude of change prior to mitigation, is considered to be medium. Therefore, there is likely to be a direct, temporary, short-term **moderate adverse** effect on local residents and users (**significant**) prior to the implementation of mitigation measures.
Secondary Mitigation	As discussed previously, a CEMP would be incorporated at this stage, which would include methods for managing surface water runoff at the Site. This would ensure the risks of surface water flooding, along with other sources, are mitigated on and off site.
Residual effects and monitoring	The sensitivity of the local residents and user groups is high, and the magnitude of change following mitigation, is considered to be negligible. Therefore, there is likely to be a **negligible** effect on local residents and users (**not significant**) prior to the implementation of mitigation measures.

Element of topic under consideration – Effects on the Existing Surface Water Drainage Ditch Network and Outfall – Water Quality	During construction the Site would discharge surface water to the existing ditch network leading to Gagle Brook to the south. A surface water management plan will be implemented for the construction phase to ensure that quantity and quality of surface water is managed. The sensitivity of the existing ditch network is considered to be high, and the magnitude of change prior to mitigation, is considered to be low. Therefore, there is likely to be a direct, temporary, short-term **moderate adverse** effect on the existing drainage network (**significant)** prior to the implementation of mitigation measures.
Secondary Mitigation	As discussed, a site surface water management plan will be adopted during the construction phase. This will manage the risk of contaminants

	entering the drainage system, ditch network and receiving watercourse. The discharge from the Site will be installed with a penstock, to allow the system to be isolated in the event of an oil or fuel spill. Drip trays are also to be used on all equipment where there is a risk of spillage, with site staff trained on required procedures in the event of a spill.
Residual effects and monitoring	The sensitivity of existing drainage system is high, and the magnitude of change, following mitigation, is negligible. Therefore, there is likely to be a **negligible** residual effect on the existing drainage system (**not significant**) following the implementation of mitigation measures.

Element of topic under consideration – Changes to Groundwater Levels During Construction	During construction the Site groundwater would need to be managed. Initial, non-intrusive surveys of the Site indicate that the Site is subject to elevated groundwater levels, especially in the south east of the Site. It is known that there are two nearby groundwater wells, Bignell Park and Chesterton Field Farm, a fall in ground water levels at these sites may reduce the rate of water abstraction. The sensitivity of the groundwater levels is considered to be moderate, and the magnitude of change prior to mitigation, is considered to be moderate. Therefore, there is likely to be a direct, temporary, medium-term **moderate to major adverse** effect on the groundwater levels (**significant)** prior to the implementation of mitigation measures.
Secondary Mitigation	Further investigative works are required to better understand the geology and ground water across the Site. This will include boreholes and long term monitoring of groundwater levels. It is not fully understood how the surrounding area will react to changes in groundwater levels and if the private water abstractions are within the zone of influence. Following the surveys and monitoring, the geological engineer will assess the minimum ground water levels across the construction zone to ensure that dewatering works during construction will not have an adverse effect on the ponds and surrounding site. Where required a management plan will be implemented, possibly using bentonite walls to protect the more surrounding areas.
Residual effects and monitoring	The sensitivity of groundwater is low, and the magnitude of change, following mitigation, is negligible. Therefore, there is likely to be a **negligible** residual effect on the groundwater (**not significant**) following the implementation of mitigation measures.

Element of topic under consideration – Contamination of Groundwater	During construction at the Site, there is an elevated risk of construction activities contaminating the ground from oil or fuel spills. The Site is a greenfield site and there is therefore a low risk of releasing existing contamination to groundwaters during the construction works. The sensitivity of the groundwater is considered to be high, and the magnitude of change prior to mitigation, is considered to be moderate. Therefore, there is likely to be a direct, permanent, long-term **moderate to major adverse** effect on groundwater (**significant)** prior to the implementation of mitigation measures.

Secondary Mitigation	As discussed previously, site investigation works are required to better understand groundwater levels and if there is any contamination prior to construction. However, none is expected due to the historic use of the site as golf course and the surrounding land use being predominantly greenfield or agriculture. A site surface water management plan will be adopted during the construction phase. This will manage the risk of contaminants entering the groundwater. Drip trays are also to be used on all equipment where there is a risk of spillage, with site staff trained on required procedures in the event of a spill.
Residual effects and monitoring	The sensitivity of groundwater is high and the magnitude of change, following mitigation, is negligible. Therefore, there is likely to be a **negligible** residual effect on the groundwater (**not significant**) following the implementation of mitigation measures.

OPERATIONAL PHASE

Element of topic under consideration – Impact on Fluvial and Pluvial Flood Risk on the Public and Local Users	Failure of the Proposed Development's surface water drainage system, due to rainfall events greater than the design event (1 in 100 year +40% climate change allowance) could lead to overland flow and inundation of local residents downstream of the Proposed Development. The sensitivity of the local residents and user groups is high, and the magnitude of change prior to mitigation, is considered to be low. Therefore, there is likely to be a direct, temporary, short-term **minor adverse** effect on local residents and users (**not significant**) prior to the implementation of mitigation measures.
Secondary Mitigation	Assessment of overland flow paths across the Site in response to proposed changes in topography carried out to ensure failure of the Proposed Development's system will not increase the risk of fluvial and/or pluvial flooding to the nearby residents or local users.
Residual effects and monitoring	The sensitivity of the local residents and user groups is high, and the magnitude of change following mitigation, is considered to be negligible. Therefore, there is likely to be a **negligible** effect on local residents and users (**not significant**) prior to the implementation of mitigation measures.

Element of topic under consideration – Effects on the Existing Surface Water Drainage Ditch Network and Outfall – Water Quantity and Rate	During operation the Site will discharge surface water to the existing ditch network leading to Gagle Brook to the south. A Drainage Strategy has been written for the operational phase to ensure that quantity and quality of surface water is managed. Where the rainfall event experienced by the Site is greater than the design rainfall events, the downstream ditch network may become inundated and cause flooding. The sensitivity of the existing ditch network is considered to be moderate, and the magnitude of change prior to mitigation, is considered to be moderate. Therefore, there is likely to be a direct, temporary, short-term **moderate adverse** effect on the existing drainage network (**significant)** prior to the implementation of mitigation measures.

Secondary Mitigation	An assessment of the downstream ditch network is to be carried out prior to construction and where required, upgrade works provided to ensure the capacity is adequate for the proposed discharge rate.
Residual effects and monitoring	The sensitivity of existing drainage system is moderate, and the magnitude of change, following mitigation, is negligible. Therefore, there is likely to be a **negligible** residual effect on the existing drainage system (**not significant**) following the implementation of mitigation measures.

Element of topic under consideration – Effects on the Existing Surface Water Drainage Ditch Network and Outfall – Water Quality	During operation the Site would discharge surface water to the existing ditch network leading to Gagle Brook to the south. The Drainage Strategy Report in **Appendix 12.2** and the Flood Risk Assessment in **Appendix 12.1** outlines how contamination will be managed in the long term The Site is a greenfield site and there is therefore a low risk of releasing existing contamination to groundwaters during the construction works. The sensitivity of the existing ditch network is considered to be high, and the magnitude of change prior to mitigation, is considered to be low. Therefore, there is likely to be a direct, temporary, short-term **moderate to major adverse** effect on the existing drainage network (**significant)** prior to the implementation of mitigation measures.
Secondary Mitigation	In the event of contamination of the surface water drainage system, the pre-mitigation interventions will prevent further contamination downstream. However, water quality from the site should be monitored and assessed at regular intervals to ensure the system is working as designed.
Residual effects and monitoring	The sensitivity of existing drainage system is high, and the magnitude of change, following mitigation, is low. Therefore, there is likely to be a direct, temporary, short-term **minor adverse** residual effect on the existing drainage system (**not significant**) following the implementation of mitigation measures.

Element of topic under consideration – Changes to Groundwater Levels	During operation the Site groundwater would need to be managed, to protect the property from flooding. The Site is thought to be subject to elevated groundwater levels, especially in the south east of the Site. It is known that there are two nearby groundwater wells, Bignell Park and Chesterton Field Farm, changes in groundwater levels may affect the rate of abstraction from these wells. The sensitivity of the groundwater levels is considered to be moderate, and the magnitude of change prior to mitigation, is considered to be low. Therefore, there is likely to be a direct, temporary, medium-term **moderate to major adverse** effect on the groundwater levels (**significant)** prior to the implementation of mitigation measures.
Secondary Mitigation	Further investigative works are required to better understand the geology and ground water across the Site. This will include boreholes and long term monitoring of groundwater levels. It is not fully understood

	how the surrounding area will react to changes in groundwater levels and if the private water abstractions are within the zone of influence. Following the surveys and monitoring, the geological engineer will assess the minimum ground water levels across the construction zone to ensure that dewatering works during construction will not have an adverse effect on the ponds and surrounding site. Where required a management plan will be implemented, possibly using bentonite walls to protect the more surrounding areas. The proposed levels to the south east of the Site are to be raised by up to 500mm to raise the proposed construction away from groundwater. Perforated pipework is to be reinstated below the car parking area to protect the tanked permeable sub-base from floatation. The level of this land drainage will be set so to avoid long term changes in groundwater levels where possible.
Residual effects and monitoring	The sensitivity of groundwater is moderate, and the magnitude of change, following mitigation, is negligible. Therefore, there is likely to be a **negligible** residual effect on the groundwater (**not significant**) following the implementation of mitigation measures.

Element of topic under consideration – Contamination of Groundwater	During operation contaminates may enter the groundwater due to oil spills, leaks from plant and leaks from the foul water system carrying trade effluent. The proposed drainage system does not include infiltration due to high groundwater levels. Therefore, there are limited pathways for contaminates to enter the groundwater in the drainage system. The existing site is a greenfield site and therefore there is a low risk of releasing existing contamination to groundwaters from the operation of the Proposed Development. The sensitivity of the groundwater is considered to be high, and the magnitude of change prior to mitigation, is considered to be moderate. Therefore, there is likely to be a direct, permanent, long-term **moderate to major adverse** effect on groundwater (**significant)** prior to the implementation of mitigation measures.
Secondary Mitigation	Monitoring of the discharge from site should be carried out at regular intervals to ensure the pre-mitigation measures are effective.
Residual effects and monitoring	The sensitivity of groundwater is high, and the magnitude of change, following mitigation, is negligible. Therefore, there is likely to be a **negligible** residual effect on the groundwater (**not significant**) following the implementation of mitigation measures.

Element of topic under consideration – Effects on the local foul sewerage network	In the operational phase, the Site foul water is to be discharged via gravity to an on-site pumping station. From here it will be pumped via rising main, approximately 500m to the nearest Thames Water foul sewer. More details are provided in the Drainage Strategy Report in **Appendix 12.2**.

	Discussions have been held with Thames Water regarding the Proposed Development. The outcome of these is that modelling work is required to ensure there is capacity in the network. This can only begin post-planning and will be carried out by Thames Water. The anticipated discharge rate of the Proposed Development is 50l/s. The sensitivity of the capacity of the Thames Water sewerage network is considered to be high, and the magnitude of change prior to mitigation, is considered to be moderate. Therefore, there is likely to be a direct, permanent, long-term **moderate to major adverse** effect on the Thames Water Sewer (**significant)** prior to the implementation of mitigation measures.
Secondary Mitigation	Thames Water are the statutory undertaker for the area and are responsible for managing and maintaining the local sewerage network and are responsible for modelling and fortifying it where required. Discussions have been held with Thames Water and they are aware of the proposals and discharge rate. They have stated the requirement for modelling works to assess the capacity of the network, however this can only commence post-planning. If there are capacity issues, Thames Water will be responsible for fortifying the network
Residual effects and monitoring	The sensitivity of Thames Water sewer is high, and the magnitude of change, following mitigation as set out above, is negligible. Therefore, there is likely to be a **negligible** residual effect on the Thames Water sewer (**not significant**) following the implementation of mitigation measures.

Element of topic under consideration – Effects on the local water authority mains cold water infrastructure network	A 'pre-planning capacity check enquiry' application was submitted to Thames Water on 29th August 2018 for a new mains cold water service to serve the Proposed Development, with an estimated annual consumption of 192,600,000 litre per annum and an estimated peak flow rate of 11 litres per second. Thames Water subsequently provided a 'Clean Water Budget Estimate' dated 19th September 2018, which detailed a new 180mm HPPE water main to serve the development, and associated metering (Thames Water have provisionally proposed 2 No. water meters at the site boundary, 1 No. to serve the waterpark, and 1 No. to serve the rest of the Proposed Development). A new mains cold water point of connection location to existing Thames Water infrastructure was identified by Thames Water circa 512m from the Site boundary. Thames Water also confirmed on the 19th September 2018 that based on their initial review, their supply network has sufficient capacity to cater for 50 dwellings of the proposed 500 key hotel. In order to cater for the requested annual consumption, Thames Water advised that they will need to carry out a 'Clean Water Hydraulic Modelling Study' to assess the network capabilities and identify appropriate upgrades or offsite reinforcement requirements

	Refer to the 'Outline Water Resources Scoping Note' in **Appendix 12.3** for additional information. Given the pre-planning capacity check feedback from Thames Water, and that Policy ESD 3: Sustainable Construction states that "*Cherwell District is in an area of water stress*", the sensitivity of the capacity of the Thames Water mains cold water infrastructure network is considered to be 'high', and the magnitude of change prior to mitigation is also considered to be 'high'. Therefore, there is likely to be a direct, permanent, long-term **major adverse** effect on the Thames Water mains cold water infrastructure network (**significant)** prior to the implementation of mitigation measures.
Secondary Mitigation	Going forward, a formal instruction, together with the associated underwriting agreement, will be submitted to Thames Water by the Applicant enabling Thames Water to proceed with the 'Clean Water Hydraulic Modelling Study', based on the reduced estimated annual water consumption requirement (i.e. 141,512,000 litres per annum as opposed to the initial application which was based on 192,600,000 litres per annum). Upon receipt of this application, Thames Water will carry out the necessary modelling works in order to definitively confirm the extent of the reinforcement works required to cater for the anticipated annual water consumption requirements, and the scope and timescales associated with any reinforcement / offsite improvement works. Thames Water have confirmed the following estimated time scales for the modelling study : Modelling: 6 months Design: 6 months Construction: 6 months Total: 18 months These works will be carried out post submission of the planning application. Thames Water are the statutory undertaker for the area and are responsible for managing and maintaining the mains cold water infrastructure network, as well as carrying out network reinforcement works required to cater for developments mains cold water supply requirements. It is envisaged that the necessary impact studies will be undertaken and secured by an appropriate pre-occupation planning condition.
Residual effects and monitoring	Thames Water are the statutory undertaker for the area and are responsible for carrying out any network reinforcement works required to cater for the developments mains cold water supply requirements With this in mind, Thames Water will demonstrate and where highlighted carry out necessary remedial works to their network, to ensure that they can cater for the developments water consumption requirements, minimising detrimental impact on other water consumers within Cherwell District. Once the identified remedial works have been carried out, the sensitivity of the capacity of Thames Water's mains cold water infrastructure network can be considered low and the magnitude of change post mitigation is considered negligible. Therefore, there is likely to be a

	negligible residual effect on the Thames Water's mains cold water infrastructure network (**not significant**) following the implementation of mitigation measures.. The resource requirement will however remain significant (i.e. circa 141,512,000 litres per annum).

12.7. LIMITATIONS AND ASSUMPTIONS

12.7.1. It is assumed that the results of the UAV Survey contained in the Flood Risk Assessment **Appendix 12.1** represent the maximum likely groundwater levels across the Site. Following the planning process, intrusive site investigations will be required across the site alongside long term groundwater monitoring

12.7.2. Infiltration testing has not been carried out at the pre-planning stage, however as there is strong evidence that the ground water level is less than 1m from the surface, infiltration devices have not been considered. This will need to be confirmed by intrusive site investigations post planning.

12.7.3. The two drainage ditches that run across the Site are understood to be solely used as land drainage and excavated by the golf course owner in the 1980's. The evidence for their use has been outlined in the Flood Risk Assessment in **Appendix 12.1**. They are not considered to be watercourses and therefore are thought to have a low sensitivity, allowing for a diversion or abandonment where required. Further assessment and review will be required following the planning process.

12.8. SUMMARY

12.8.1. Site discharge will be managed to ensure that contaminants are managed on site. However, in the event that contaminants are spilt in areas not managed by surface water drainage, or enter the overland flow swales, there is a potential low adverse residual effect of contamination to the downstream ditch network.

12.8.2. Surface water management plans are to be implemented in the construction phase to manage the risk of flooding and contamination, both to the existing downstream drainage system and the groundwater. This will ensure that post development flows are no greater than the anticipated greenfield run-off rates.

12.8.3. The Drainage Strategy Report and Flood Risk Assessment, contained in **Appendices 12.1** and **12.2** respectively outline how flooding and contamination will be managed in the operational phase.

12.8.4. Further surveys are required across the Site to better understand the underlying geology and groundwater. Long term monitoring of groundwater levels is required to understand how the groundwater is fed and how the surrounding sensitive receptors will react to changes in groundwater levels.

12.8.5. Following a pre-planning enquiry, Thames Water have been consulted with and commissioned, and are now in the process of undertaking a clean water hydraulic modelling study to further assess the impact of the Proposed Development on the existing network. This should identify the offsite reinforcement is required to maintain a similar level of service within the local Flow Management Zone (FMZ). Continuing to work with Thames Water, further consideration will be given to the strategy and mitigation measures to reduce consumption. The report that will be produced by the modelling exercise should demonstrate the reinforcements required to facilitate the Proposed Development, whilst maintaining a similar level of service. The Applicant will commit to the

necessary reinforcement required to supply the site. Please refer to the 'Outline Water Resources Scoping Note' in **Appendix 12.3** which includes copies of relevant correspondence with Thames Water.

Table 12.1 - Summary of Effects Table for Water Resources, Flood Risk and Drainage

Description of Effects	Receptor	Significance and Nature of Effects Prior to Mitigation / Enhancement	Summary of Mitigation / Enhancement	Significance and Nature of Effects Following Mitigation / Enhancement (Residual)
Construction Phase				
Flooding	Construction Workers	Minor adverse (not significant) - / T / D / ST	Implementation of CEMP and surface water management plan	Negligible (not significant)
Flooding	Local Residents and Users	Moderate adverse (significant) - / T / D / ST	Implementation of CEMP and surface water management plan	Negligible (not significant)
Water Quality	Existing Downstream Drainage System	Moderate adverse (significant) - / T / D / ST	Implementation of CEMP and surface water management plan	Negligible (not significant)
Groundwater levels	Private Water Abstractions and Existing Ponds	Moderate to major adverse (significant) - / T / D / MT	Implementation of CEMP and surface water management plan Investigations into groundwater levels and zone of influence	Negligible (not significant)

			Potential use of bentonite barriers and land drains	
Groundwater Contamination	Private Water Abstractions and Existing Ponds	Moderate to major adverse (significant) - / T / D / LT	Implementation of CEMP and surface water management plan Investigations into groundwater levels and zone of influence Potential use of bentonite barriers and land drains	Negligible (not significant)
Operational Phase				
Flooding	Local Residents and Users	Minor adverse (not significant) - / T / D / ST	Implementation of Drainage Strategy Reduction in discharge from site Use of rainwater harvesting to reduce the volume of water emanating from site Assessment of overland flow and failure path	Negligible (not significant)
Water Quantity	Existing Downstream Drainage System	Moderate adverse (significant) - / T / D / ST	Implementation of Drainage Strategy Reduction in discharge from site Use of rainwater harvesting to reduce the volume of water emanating from site	Negligible (not significant)

			Assessment of downstream network capacity and review of system fortifying works.	
Water Quality	Existing Downstream Drainage System	Moderate to major adverse (significant) - / T / D / ST	Implementation of Drainage Strategy Use of permeable pavements and penstocks Oil interceptors to be used where required. Regular monitoring of site surface water discharge to sample for contaminates	Minor adverse (not significant) - / T / D / ST
Groundwater levels	Private Water Abstractions and Existing Ponds	Moderate to major adverse (significant) - / T / D / MT	Investigations into groundwater levels and zone of influence Potential use of bentonite barriers and land drains Raising of car park levels to reduce effect of car parking construction on groundwater. Land drainage regime to be similar to that of the pre-developed site	Negligible (not significant)
Groundwater Contamination	Private Water Abstractions	Moderate to major adverse (significant)	Use of permeable pavements and penstocks	Negligible (not significant)

	and Existing Ponds	- / T / D / LT	Oil interceptors to be used where required.	
Foul Discharge to Public Sewer	Thames Water Sewer	Moderate to major adverse (significant) - / P / D / LT	Thames Water to model and fortify the network where required	Negligible (not significant)
Capacity of local mains cold water infrastructure	Thames Water mains cold water infrastructure	Major adverse (significant) - / P / D / LT	Thames Water to undertake 'Clean Water Hydraulic Modelling Study'. Thames Water to carry out modelling to identify the reinforcement/improvement works required.	Negligible (not significant)

NB: Aspects of the Proposed Development considered as part of the pre-mitigation scenario are summarised above in Section 12.5.

Key to table:

+ / - = Beneficial or adverse P / T = Permanent or Temporary, D / I = Direct or Indirect, ST / MT / LT = Short Term, Medium Term or Long Term N/A = Not Applicable

12.9. REFERENCES

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- **Ref 12.15**: Environment Agency Flood Map for Planning. Available at: http://apps.environment-agency.gov.uk/wiyby/37837.aspx
- **Ref 12.16**: Oxfordshire County Council online resources. Available at: https://www.oxfordshire.gov.uk/
- **Ref 12.17**: Information from the British Geological Survey (BGS) Geoindex service: bedrock and superficial geology. Available at: http://www.bgs.ac.uk/Geoindex/
- **Ref 12.18**: Information from the National River Flow Archive. Available at: https://nrfa.ceh.ac.uk/
- **Ref 12.19**: Information from Natural England Open Data Geoportal. Available at: https://naturalengland-defra.opendata.arcgis.com/