CHAPTER 10:

WATER RESOURCES AND FLOOD RISK

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10.0 WATER RESOURCES AND FLOOD RISK

10.1 Scope of Assessment

10.1.1 This chapter of the ES assesses the likely significant effects of the Proposed Development in terms of Water Resources and Flood Risk and is supported by a Flood Risk Assessment and Sustainable Drainage Systems (SuDS) Strategy report (included as **Volume 4, Appendix D** of this ES).

10.1.2 The Water Resources and Flood Risk Chapter describes: the assessment methodology; the baseline conditions currently existing at the Site and in the surrounding area; the likely significant environmental effects; the mitigation measures required to prevent, reduce or offset significant adverse effects; the likely residual effects after these measures have been employed; and the cumulative effects associated with the Proposed Development in combination with other major developments within a 3.5 km radius of the Site.

10.1.3 'Intra-project effects' which are the combined effects of individual topic impacts on a particular sensitive receptor are considered in **Volume 2 Chapter 14: Effect Interactions**.

10.2 Key Legislation, Policy and Guidance Considerations

10.2.1 The Water Resources and Flood Risk assessment has been undertaken within the context of relevant planning policies, guidance documents and legislative instruments. These are summarised below.

Legislation and Regulation

The Water Framework Directive and the Water Environment (Water Framework Directive) (England and Wales) Regulations (2017)

10.2.2 The Water Framework Directive[1] (WFD) provides a framework for a European-wide approach to water policy with the aim of ensuring no deterioration from their current status for all inland and near shore watercourses and water bodies, (including groundwater), and to ensure attainment of 'Good' status or better, in terms of ecological, chemical, biological and physical parameters. Therefore, any activities or developments that could cause detriment to a nearby water resource or prevent the future ability of a water resource to reach its target status, must be mitigated so as to reduce the potential for harm and allow the aims of the WFD to be realised.

The Groundwater (England and Wales) Regulations (2009)

10.2.3 These Regulations[2] aim to prevent the input of hazardous substances and limit the input of non-hazardous pollutants to groundwater. A hazardous substance is defined as any substance or group of substances that are toxic, persistent and liable to bio-accumulate.

[1] The European Parliament and the Council of the European Union (2000) Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy OJ L 327, 22.12.2000, p. 1–73

[2] https://www.legislation.gov.uk/ukdsi/2009/9780111480816/contents

Flood and Water Management Act (2010)

10.2.4 This Act[3] provides for better, more comprehensive management of flood risk for people, homes and businesses, and gives guidance on sustainable drainage and flood resistant construction. This Act identifies upper tier Local Authorities (LA) to have responsibility in the management and leadership of local flooding issues as the Lead Local Flood Authority (LLFA).

Building Regulations (2010) Drainage and Waste Disposal

10.2.5 These Regulations[4] provide an order of priority for measures for the disposal of rainwater from roofs and paved areas. First order of priority is a soakaway or infiltration system, followed by discharge into a nearby watercourse and finally, discharge to a public sewer.

10.2.6 Regulation of drainage from buildings is provided by Part H of the Building Regulations, Drainage and Waste Disposal[5].

Local and National Planning Policy

National Planning Policy Framework (2021)

10.2.7 National planning policy is governed by the National Planning Policy Framework[6] (NPPF) which requires that new development should be sustainable and meet the challenges posed by climate change, flooding and coastal change. The NPPF requires that flood risk assessments for new development review flooding from all potential sources. Implementation of this requirement is met by the associated Planning Practice Guidance for Flood Risk and Coastal Change[7].

10.2.8 The NPPF states that sequential or exception tests should be undertaken for developments in Flood Zone 2 or 3.

Sustainable Drainage Systems: Non-statutory technical standards for sustainable drainage systems (DEFRA, March 2015)

10.2.9 This document[8] sets out the non-statutory technical standards for sustainable drainage systems. They should be used in conjunction with the National Planning Policy Framework and Planning Practice Guidance.

10.2.10 The standards describe how the peak runoff rate and volume from new developments should be controlled, in addition to providing guidance on the structural integrity of new drainage systems, designing for long-term management and maintenance, and also construction considerations.

Local Planning Policy

10.2.11 Furthermore, a review of local planning policies was carried out and a summary of their

[3] TSO (2010) Flood and Water Management Act SI 2010 C.29

[4] http://www.legislation.gov.uk/uksi/2010/2214/contents/made

[5] HM Government (2010) The building regulations 2010 Part H drainage and waste disposal (2015 edition).

[6] HM Government (2018) National Planning Policy Framework. Ministry of Housing, Communities and Local Government, July 2021

[7] Planning Practice Guidance. Flood Risk and Coastal Change, updated 6/3/2014. Accessed from https://www.gov.uk/guidance/flood-risk-and-coastal-change on 10/09/2019

[8] https://www.gov.uk/government/publications/sustainable-drainage-systems-non-statutory-technical-standards

relevant policies is provided below:

- Development should be directed to areas at lowest risk of flooding (fluvial, pluvial, sewer and groundwater) and designed to reduce flood risk where possible – this is stated in the Reading Borough Council (RBC) Local Plan[9] (November 2019), the RBC Local Flood Risk Management Strategy[10] (October 2014) and the Reading Borough Core Strategy[11] (January 2015);

- All major developments must incorporate sustainable drainage systems (SuDS) as appropriate and in line with the Government's Technical Standards, which provide guidance on the adoption and maintenance of SuDS as stated in various planning policy documents such as RBC's Local Plan, Strategic Flood Risk Assessment (SFRA) [12] (June 2017), Local Flood Risk Management Strategy (October 2014), Core Strategy (January 2015) and Revised Sustainable Design and Construction Supplementary Planning Document[13] (December 2019); and

- Consideration of adaptation to climate change when assessing flood risk as stated in RBC's Sites and Detailed Policies Document[14] (January 2015) and Climate Change Strategy 2013-2020[15].

Technical Standards and Guidance

10.2.12 Technical Standards and guidance are provided by the NPPF Planning Practice Guidance for Flood Risk and Coastal Change and Part H of the Building Regulations referred to above. In addition, guidance on the design of Sustainable Drainage Systems (SuDS) is provided by DEFRA non-statutory technical standards and by "The SuDS Manual" published by CIRIA[16]. This guidance has been used to inform the production of the ES Chapter on Water Resources and Flood Risk.

10.2.13 The Environment Agency's Climate Change Allowances (2021) are predictions of anticipated changes in peak river flow by river basin district; peak rainfall intensity; sea level rise; offshore wind speed and extreme wave height. They are produced to enable flood risk assessments to make allowances for climate change to help minimise vulnerability and provide resilience to flooding. This is further detailed in the Flood Risk Assessment and Sustainable Drainage Systems (SuDS) Strategy included in **Volume 4, Appendix D** of this ES.

[9] http://www.reading.gov.uk/media/10410/Reading-Borough-Council-Local-Plan/pdf/Local_Plan_Adopted_November_2019.pdf

10 http://www.reading.gov.uk/media/7560/Strategic-Environmental-Assessment-SEA-Scoping-Report/pdf/27560_RBC_LLFA_SEA_Scoping_Report.pdf

[11] http://www.reading.gov.uk/media/1046/Core-Strategy-Adopted-January-2008/pdf/Core-Strategy-Adopted-Jan08-Altered-Jan15.pdf

[12] http://www.reading.gov.uk/media/7330/Main-report/pdf/SFRA_main_June_17.pdf

[13] http://www.reading.gov.uk/media/1069/Sustainable-Design-and-Construction-Supplementary-Planning-Document-Adopted-July-2011/pdf/Sustainable-Design-and-Construction-Supplementary-Planning-Document.pdf

[14] http://www.reading.gov.uk/media/1049/Sites-and-Detailed-Policies-Adopted-October-2012/pdf/SDPD-Adopted-Oct12-Altered-Jan15.pdf

[15] https://www.reading.gov.uk/media/1232/Climate-Change-Strategy/pdf/Climate-Change-Strategy.pdf

[16] The SuDS Manual Version 2. CIRIA Report C753, 2015

10.3 Assessment Methodology

10.3.1 The proposed assessment methodology applied during the preparation of the ES Chapter on Water Resources and Flood Risk is presented in the following sections.

Determination of Baseline

10.3.2 The Site is located at Ordnance Survey (OS) national grid reference SU 71889 76888 as shown on the latest Masterplan (November 2021). It has an area of approximately 12.15 ha and currently comprises the Reading Golf Course in the village of Emmer Green, circa 3 km north of Reading town centre. The Proposed Development will comprise demolition of the existing clubhouse and the erection of a residential scheme (C3 use to include affordable housing) at the former Reading Golf Club. The Proposed Development will comprise up to 223 residential homes (including 1 and 2 bedroom flats, and 2, 3, 4 and 5 bedroom houses to include social rent, affordable housing and private housing).

10.3.3 The baseline has been determined by describing the environmental conditions of the Site at the time of the assessment and has been informed using environmental information provided by the Environment Agency (EA), the British Geological Survey (BGS) and other published sources. In addition the following Site specific sources have been used:

- 'Reading Golf Club Environmental Assessment' (GEA-21962B-19-476, Idom, 2019)
- Reading Golf Club Ground Investigation Report (GE19428-GIR-DEC20, Geo-Environmental, 2020)
- Reading Golf Club Supplementary Ground Investigation Report (GE20079/ SGIR/ OCT21, Geo-Environmental, October 2021)

10.3.4 The above are included in **Volume 4, Appendix F** of this ES.

10.3.5 The baseline assessment identifies all potential water resources and flood risk receptors that could be affected by the Proposed Development.

Prediction Methodology

10.3.6 The prediction methodology has followed the approach set out in **Volume 2, Chapter 3: EIA Methodology** of this ES.

10.3.7 The significance of an effect has been determined by assessing the value/sensitivity of the resource and the magnitude of the impact as shown in **Table 10.2**, **Table 10.3** and **Table 10.4**.

Table 10.2: Determining Value/Sensitivity of Resource

Value / Sensitivity	Typical Descriptors Example of Typical Receptors		
High	Attribute has a high quality and rarity on an international, regional or national scale.	**Surface Waters:**	EC Designated Salmonid / Cyprinid fishery/ Major Cyprinid Fishery High or Good Ecological Quality Species protected under EU or UK

Value / Sensitivity	Typical Descriptors Example of Typical Receptors		
			wildlife legislation (SAC, SPA, SSSI, Ramsar site)
		Groundwater:	Principal aquifer providing a strategically or regionally important resource or supporting Site protected under wildlife legislation Source Protection Zone (SPZ) I
		Flood Risk:	Flood plain or defence protecting more than 100 residential properties from flooding
Medium	Attribute has a medium quality and rarity on a local scale.	**Surface Waters:**	Moderate Ecological Quality.
		Groundwater:	Secondary aquifer (A or B) providing locally important resourced or supporting river ecosystem SPZ II
		Flood Risk:	Flood plain or defence protecting between 1 and 100 residential properties or industrial premises from flooding
Low	Attribute has a low quality and rarity on a local scale.	**Surface Waters:**	Poor or Bad Ecological Quality
		Groundwater:	Aquifer providing water for agricultural or industrial use with limited connection to surface water Unproductive strata SPZ III
		Flood Risk:	Flood plain or defence protecting 10 or fewer industrial properties from flooding Flood plain with limited constraints and low probability of flooding of residential and industrial properties

Table 10.3: Determining Magnitude of Impact

Magnitude of Potential Change		Criteria
Major	Adverse	Results in loss of attribute and/or quality and integrity of the attribute
	Beneficial	Results in major improvement of attribute quality.
Moderate	Adverse	Results in effect on integrity of attribute, or loss of part of attribute.
	Beneficial	Results in moderate improvement of attribute quality.
Minor	Adverse	Results in some measurable change in attribute's quality or vulnerability.
	Beneficial	Results in some beneficial effect on attribute or a reduced risk of negative effect occurring.
Negligible		Results in effect on attribute, but of insufficient magnitude to affect the use or integrity.

Table 10.4: Effect Significance Matrix

Magnitude	Sensitivity of Value			
	High	Medium	Low	Very Low
Major	Major	Moderate	Moderate	Negligible
Moderate	Moderate	Moderate	Minor	Negligible
Minor	Moderate	Minor	Negligible	Negligible
Negligible	Negligible	Negligible	Negligible	Negligible

Information Sources

10.3.8 This assessment has been informed by the following information sources, plans and reports produced for the Site:

- Planning statement describing the composition of the Proposed Development;
- Proposed Development Masterplan '2036-SK04 Rev J Indicative Site Layout - BASE b & w' produced in May 2020;
- Flood Risk Assessment and Sustainable Drainage Systems (SuDS) Strategy (included in **Volume 4, Appendix D** of this ES);
- Phase 1 Contamination Risk Assessment produced by Ground and Environmental Services Limited in February 2019 (included in **Volume 4, Appendix F** of this ES);

- Geo-Environmental Assessment produced by IDOM in November 2019 including infiltration testing results and land quality;
- Ground Investigation Reports produced by Geo-Environmental in December 2020 and October 2021 including infiltration testing and land quality;
- British Geological Survey website; and
- Environment Agency

Limitations and Assumptions

10.3.1 The work undertaken to provide the basis of this Chapter is limited to the assumptions and limitations of the reports noted above.

10.3.2 A site walk-over was undertaken in March 2020 to observe the general site setting and identify the visible site drainage.

Consultation

10.3.3 A Scoping Report **(Volume 4, Appendix A1)** was submitted to RBC in January 2020 with a formal request for an EIA Scoping Opinion in accordance with Regulation 15 of the EIA Regulations. As part of this process the key statutory and non-statutory consultees were consulted to review the proposed methodology and criteria for assessment. RBC subsequently issued their Scoping Opinion on the 15h April 2020 commenting on the proposed scope and methodology of the topics for assessment within the EIA including further comments from Natural England (subsequently received on the 24th April 2020). A copy of the Scoping Opinion is provided in **Volume 4**, **Appendix A2**.

10.3.4 A summary of the key points raised in the Scoping Opinion relevant to Water Resources and Flood Risk are presented in **Table 10.5**, including a response as to where the comments have been addressed within this chapter. No Scoping Opinion response from the Environment Agency was provided.

10.3.5 Additionally, Thames Water was consulted and raised no objection following review of the Scoping Report.

Table 10.5 RBC Scoping Opinion Comments and Response

Consultee	Summary of Comment	Location within the ES where comments are addressed
Reading Borough Council (15/04/2020)	The Scoping Report states the underlying bedrock geology is classified as a Principal Aquifer where the bedrock is comprised of the Seaford Chalk and a Secondary (A) Aquifer where the bedrock is formed of the Lambeth Group. The Site is located within Source Protection Zone III (Total Catchment). Ground water contamination should therefore be assessed.	Section 10.6.6. Supporting information contained in the Phase 1 Contamination Risk Assessment produced by Ground and Environmental Services Limited in February 2019 (Volume 4, Appendix F) and the GeoEnvironmental Assessment produced by IDOM in November 2019 including infiltration testing results and land quality.
	Surface water quality should be assessed and the location of the temporary site discharge points should be clarified.	Section 10.6.5. Code of Construction Practice (CoCP). Further information contained in the Flood Risk Assessment and SuDS Strategy (Volume 4,

Consultee	Summary of Comment	Location within the ES where comments are addressed
		Appendix D). Location of the temporary site discharges will be determined by the appointed contractor before construction. However, the four infiltration basins that will serve the proposed development (Volume 4, Appendix D) could be constructed first so that they could also serve as construction phase drainage receptors, provided adequate sediment and pollution control measures are put in place by the contractor.
	Thames Water should be consulted to ensure that there is sufficient capacity within the foul drainage network and sewage treatment works to accommodate the proposed development. This is to ensure that there is no detrimental impact on controlled waters, in accordance with Paragraph 109 of the National Planning Policy Framework (NPPF).	Section 10.3.5 Existing utilities assessment carried out by Ridge and Partners LLP.
Natural England (20/04/2020)	The ES should identify how the development's effects on the natural environment will be influenced by climate change.	Flood Risk Assessment and SuDS Strategy (Volume 4, Appendix D)
	The ES should include an impact assessment to identify, describe and evaluate the effects that are likely to result from the project in combination with other projects and activities that are being,	Section 10.8

10.4 Baseline Assessment and Identification of Key Receptors

Flood Risk – Rivers and Sea

10.4.1 According to the Environment Agency's Flood Map for Planning, the Site is located within Flood Zone 1 (i.e. Low Probability of flooding from rivers and the sea). The proposals are for the "More Vulnerable" (i.e. residential) land use category under the PPG, although this and all other types of development are considered acceptable for location in Flood Zone 1 (PPG Tables 2 and 3) as described in the Flood Risk Assessment and Sustainable Drainage Systems (SuDS) Strategy (**Volume 4, Appendix D**) As a result, the impacts to (or from) the Proposed Development from (or on) flood risk from rivers and the sea is not considered any further in this chapter.

Flood Risk - Drainage and Surface Water (Pluvial) flooding

10.4.2 The EA's Flood Map for Surface Water indicates that a surface water flow pathway runs along the northern part of the Site, which flows from the south west to the north east. The EA's Flood Map for Surface Water indicates that this surface water flow pathway has a low risk of flooding meaning that each year this area has a chance of flooding of between 0.1% and 1%.

10.4.3 According to the EA's Flood Map for Surface Water, there is a very low risk of pluvial

flooding across the majority of the Site. There is an area in the south-eastern corner of the Site which is considered to be medium to high risk. However, this area represents only a relatively small percentage of the overall Site area and is likely to be a result of surface water accumulating in a local depression. Further information on drainage and surface water flooding, including the location of the surface water flow pathway is provided in **Volume 4, Appendix D**.

10.4.4 An existing Thames Water foul sewer is present in the northern part of the site and this sewer broadly follows the alignment of the surface water flow pathway mentioned above. This foul sewer will be diverted as part of the Proposed Development.

Flood Risk – Groundwater

10.4.5 The Flood Risk Assessment (FRA) for the Site (**Volume 4, Appendix D**) concludes that it is unlikely that significant groundwater reserves are present beneath the Site at elevations close enough to existing ground levels to present a potential risk of groundwater flooding. As a result, the impacts of the Proposed Development on flood risk from groundwater is not considered any further in this chapter.

Flood Risk - Flood Defences

10.4.6 The Site is located in PPG Flood Zone 1 and, as such, there are no formal flood defences nearby. As a result, the impacts of the Proposed Development on flood defences is not considered any further in this chapter.

Flood Risk - Historic Flooding

10.4.7 According to the Environment Agency's historic flood map and the SFRA, no historical flood events have been recorded at the Site.

Hydrogeology

10.4.8 British Geological Survey mapping indicates that there are superficial deposits of the Black Park Gravel Member of the Thames Valley Formation underlying the Site which is classified as a Secondary Aquifer A. These comprise sand and gravel, with possible lenses of silt, clay or peat. The underlying bedrock geology is comprised of the Seaford Chalk, classified as Principal Aquifer, to the north of the Site and the Lambeth Group (clay, silt and sand) to the south of the Site, which is classified as a Secondary (A) Aquifer (EA, 2018). The Site is located within a groundwater Source Protection Zone (SPZ) III (Total Catchment) (EA, 2018).

10.4.9 Based on the Geoenvironmental Assessment report (**Volume 4, Appendix F**), there are no licensed potable water abstractions within 2000 m of the Site. Based on open-source data available on GeoIndex[17], Reading Golf Course owns a private licensed abstraction (SU77/166) located circa 100 m to the north of the Site, within Cucumber Wood, with an estimated consumption of 350,000 galls/week (as per the 1991 record)[18]. There are no other abstraction licenses listed within 250 m of the Site.

Local Designations and Sensitive Areas

10.4.10 Within 1 km of the Site, there are no:

[17] http://mapapps2.bgs.ac.uk/geoindex/home.html

[18] http://scans.bgs.ac.uk/sobi_scans/boreholes/427877/images/10761129.html

- Sites of Special Scientific Interest (SSSIs);
- National Parks;
- Areas of the Broads;
- World Heritage Sites;
- Countryside Stewardship Special Project Areas;
- Nature Improvement Areas (NIA);
- Ramsar sites;
- Special Areas of Conservation (SAC);
- Special Protection Areas (SPA); or
- Biosphere Reserves.

10.4.11 There are two ancient woodlands in close proximity to the Site: Cucumber Wood to the north and Chambers Copse circa. 111 m to the north-west.

10.4.12 There is one Area of Outstanding Natural Beauty (AONB) located circa 1500 m to the north-west of the Site and one Local Nature Reserve (LNR) circa 373 m to the east.

Summary of Baseline Assessment

10.4.13 To summarise the findings of the baseline assessment, the EA's Flood Map for Surface Water indicates that a surface water flow pathway runs along the northern part of the Site, which flows from the south west to the north east. Due to the low risk of flooding assigned to this surface water flow pathway, the sensitivity of this feature is considered to be Low during construction. During operation, and as a result of ground works during construction and the creation of the SuDS scheme for the Site, this surface water flow pathway is unlikely to remain present and, as such, the sensitivity of this receptor during operation is not applicable.

10.4.14 The existing Thames Water foul sewer will be diverted and retained as part of the Proposed Development and, as such, its sensitivity is considered Low during both construction and operation.

10.4.15 The underlying bedrock geology is classified as a Principal Aquifer where the bedrock is comprised of the Seaford Chalk and a Secondary (A) Aquifer where the bedrock is formed of the Lambeth Group. Another Secondary A Aquifer (part of the Thames Valley Formation) is also present. The Site is located within a SPZ III (Total Catchment). As such, the sensitivity of any groundwater present beneath the Site will be assessed as Low for both the construction and operational phases.

10.4.16 Finally, Reading Golf Course owns a private licensed abstraction (SU77/166) located circa 100 m to the north of the Site, within Cucumber Wood. The licensed abstraction is located within SPZ III meaning that the sensitivity of this abstraction is Low during construction. At the time of preparing this chapter, no information is available regarding the continuing use of this abstraction during the operation phase but it could be assumed that this abstraction will be made obsolete following the golf course closure and, as such, the sensitivity of this receptor during operation is not applicable.

10.4.17 Key receptors and their sensitivity during construction and operation are summarised in **Table 10.5**, and further details provided below.

Table 10.5 Summary of Key Sensitive Receptors

Key Receptor	Sensitivity During Construction	Sensitivity During Operation
Surface water flow pathway	Low	n/a
Thames Water foul sewer	Low	Low
Groundwater – Principal Aquifer	Low	Low
Groundwater – Secondary (A) Aquifer (Thames Valley Formation)	Low	Low
Groundwater – Secondary (A) Aquifer (Lambeth Group)	Low	Low
Private licensed abstraction (SU77/166)	Low	n/a

10.5 Identification and Description of Changes Likely to Generate Effect

Likely Changes During Application Site Preparation and Proposed Development Construction

10.5.1 There may be a potential temporary adverse impact on the water environment during the construction phase of the Proposed Development, particularly in relation to the release/erosion of sediment and soil, potential contamination from hydrocarbons/other chemical use, and through construction phase surface water runoff. This could have a minor impact on the water quality of the surface water flow pathway (and associated downstream watercourses) as well as an indirect impact on groundwater bodies (Principal Aquifer and Secondary Aquifer A).

10.5.2 The local water environment may also be affected by the remobilisation of fertilisers, pesticides and herbicides, used to maintain the golf course and which have accumulated within the existing soils, if released during the construction phase. The potential release of contaminants into the water environment could have a minor impact on the water quality of the surface water flow pathway (and associated downstream watercourses) as well as an indirect impact on groundwater bodies (Principal Aquifer and Secondary Aquifer A).

10.5.3 Construction activities may also lead to the disturbance and mobilisation of physical contaminants (i.e. dust, sediments and muds). In particular, during periods of heavy rainfall, vehicle movements may generate increased surface water runoff with high volumes of suspended solids which could have a minor impact on the water quality of the surface water flow pathway (and associated downstream watercourses).

10.5.4 Compaction and disturbance of soils during construction can lead to increased volumes of surface runoff during heavy rainfall, and normal surface water flow routes may be blocked or diverted by temporary structures or embankments. This could result in a minor flood risk impact on the surface water flow pathway (and associated downstream watercourses).

10.5.5 Contaminants, oils, construction materials and suspended sediments have the potential to affect surface and groundwater bodies via surface runoff, shallow interflow and infiltration. Construction activities such as piling and/or ground excavation may create new pollutant pathways from the surface to the underlying groundwater bodies

and this could lead to a minor impact on the water quality of the surface water flow pathway (and associated downstream watercourses) as well as an indirect impact on groundwater bodies (Principal Aquifer and Secondary Aquifer A).

10.5.6 Construction activities may also lead to modified hydrological connectivity affecting flood risk and reducing infiltration due to soil disturbance and soil compaction. As a result, the potential impact on the surface water flow pathway (and associated downstream watercourses) and on groundwater during construction could be moderate.

Likely Changes Arising from Operation of the Proposed Development

10.5.7 During the operational phase, the area of impermeable hardstanding producing surface water runoff will increase significantly as a result of the Proposed Development, and climate change is expected to increase rainfall amounts by 40% over its design lifetime. This will together increase the volume and rate of surface runoff generated from the Site, which could increase flood risk in the receiving water environment if not properly managed (specifically, the watercourses into which the surface water flow pathway discharges). As a result, the Proposed Development would potentially have a major impact on surface water flood risk in the surrounding area in the absence of appropriate mitigation. The increase in impermeable area would also have an indirect impact on groundwater levels (i.e. through reduced infiltration) resulting in a minor impact on the Principal Aquifer and Secondary Aquifer A.

10.5.8 The potential for operational-phase contamination of the surrounding water environment is relatively low, given that the proposed land use will be largely residential. The main operational-phase pollution risks, therefore, are associated with hydrocarbons from fuel/oil leaks from vehicles, and dust and sediment loading of surface water runoff. This could have a minor impact on the water quality of the surface water flow pathway (and associated downstream watercourses) as well as an indirect impact on groundwater bodies (Principal Aquifer and Secondary Aquifer A).

10.5.9 The Site lies entirely within PPG Flood Zone 1 (Low Probability i.e. the area of lowest flood risk as defined by the EA) and minor localised and isolated occurrences of pluvial flooding are noted to exist on-site but will most likely be removed during the main earthworks. A minor low-risk pluvial flow path is shown to be present flowing from the south-west to the north-east in the northern part of the Site. The impacts of flood risk (fluvial and pluvial) on the Proposed Development during operation are likely to be negligible and this is detailed in the Flood Risk Assessment (**Volume 4, Appendix D**).

10.6 Assessment of Likely Significant Effect

Construction Phase

Embedded Mitigation Measures

10.6.1 Good water management practice implemented through a Code of Construction Practice (CoCP) will be used to minimise construction impacts and will be subject to regular monitoring. This is likely to be delivered through a Construction Environmental Management Plan (CEMP), which would be expected to adhere to industry best practice measures, for example, CIRIA guidance on the management of water quality and surface water runoff during construction projects. The CEMP should also include a Soil Management Plan (SMP) to ensure that excavated soil, potentially containing fertiliser and pesticide residues, is sustainably managed and does not present a pollution or flood risk to the surrounding water environment.

10.6.2 The CoCP will include measures on the use of fuels, hydrocarbon and construction chemicals, provision of Site worker accommodation and sanitation facilities and management and removal of waste materials.

10.6.3 Management of surface water and groundwater will also feature in the CoCP and will include attenuation and settlement of construction phase storm water and measures to manage any groundwater ingress into excavations.

10.6.4 The SuDS Strategy for the operational phase will utilize four infiltration basins to sustainably manage runoff from the Proposed Development. These basins should be installed at the start of construction activities so that they also serve to manage storm water during the construction phase. The CoCP and CEMP will include measures to ensure that runoff entering these infiltration basins is not polluted by contaminants (e.g. sediment and hydrocarbons) during construction activities.

Anticipated Effects

Discharge of Surface Water

10.6.5 The installation of construction site drainage to intercept and control runoff from worked areas, and refuelling on areas of hardstanding away from watercourses and surface water drains, will be required as part of the CoCP and CEMP, in addition to a construction phase Soil Management Plan. These will represent embedded mitigation measures designed to prevent contaminated water reaching the four infiltration basins during the construction phase. With these measures in place, the impact of the Proposed Development on the water quality of the surface water flow pathway (and associated downstream watercourses) and underlying groundwater during the construction phase is anticipated to be **negligible**.

Effects from Construction Activities on Water Quality

10.6.6 Construction activities, including dewatering, drilling and piling are likely to have an impact on the groundwater in the underlying Principal Aquifer and Secondary Aquifers. With the appropriate pollution control measures in place, as detailed in the CoCP, the resultant effects on groundwater are considered to be **negligible**.

10.6.7 A summary of mitigation measures and anticipated residual effects is provided in **Table 10.7**.

Operational Phase

Embedded Mitigation Measures

10.6.8 Surface water attenuation measures will be required in order to prevent an increase in flood risk elsewhere. The SuDS Strategy (**Volume 4, Appendix D**) addresses this issue and ensures that the proposed SuDS scheme for the Proposed Development delivers multiple water quality, biodiversity, and amenity benefits.

10.6.9 Existing Greenfield runoff rates have been calculated and the SuDS Strategy demonstrates that the post-development runoff rates and volumes under the 6-hour duration 1 in 100 year event will be managed and controlled in accordance with the relevant guidance documents, whilst allowing for a 40% increase in rainfall intensity due to climate change[9].

10.6.10 The SuDS Strategy for the Site will be agreed in advance by the Lead Local Flood

Authority (LLFA), which is likely to undertake the long-term adoption and maintenance of any proposed SuDS features.

10.6.11 The detailed design of the proposed SuDS features will ensure that the potential impact for contamination of the water environment from these sources will be negligible.

10.6.12 A detailed drainage strategy will be produced, secured by a planning condition, to ensure adequate attenuation and treatment is provided. The inclusion of SuDS measures, detailed in the operational phase drainage strategy (**Volume 4, Appendix D**) will further reduce the rate and volume of surface water discharges, and also improve the water quality of these discharges, when compared with baseline. The proposed SuDS measures comprise four infiltration basins and the use of permeable paving. The Flood Risk Assessment and SuDS Strategy (**Volume 4, Appendix D**) demonstrates that these features will be sufficient to dispose of all surface water generated by the proposed development to ground through infiltration during the 1 in 100 year (+40% for climate change) event.

10.6.13 The Site lies entirely within PPG Flood Zone 1 (Low Probability i.e. the area of lowest flood risk as defined by the EA). However, due to its size, a Flood Risk Assessment (FRA) has been prepared (**Volume 4, Appendix D**) and will be submitted in support of the planning application.

10.6.14 Minor localised and isolated occurrences of pluvial flooding are noted to exist on-site but will be removed during the main earthworks. A minor low-risk pluvial flow path is shown to be present flowing from the southwest to the northeast in the northern part of the Site. However, the FRA (**Volume 4, Appendix D**) demonstrates that the proposed SuDS features will intercept this flow path and manage it (as part of exceedance route management) so that it does not pose a flood risk to the proposed properties, nor that the Proposed Development will increase flood risk elsewhere.

10.6.15 Water conservation measures to reduce water use should be developed to meet water demand and should include measures such as the use of flow control devices and water efficient fixtures and fittings installed in all dwellings to target a maximum internal daily water consumption of 110 litres/person/day to align with Building Regulations and the RBC Revised Sustainable Design and Construction Supplementary Planning Document[13].

Anticipated Effects

10.6.16 As outlined in the SuDS Strategy (**Volume 4, Appendix D**), the drainage scheme will be designed with infiltration features to manage increased rainfall and runoff without increasing flood risk elsewhere. The resultant effect is therefore deemed to be **negligible**. The drainage scheme will also be designed to prevent groundwater pollution and as a result the effect on water quality is also considered to be **negligible**.

10.6.17 Residential units will target a water efficiency standard of 110 litres/person/day as stated in the RBC Revised Sustainable Design and Construction Supplementary Planning Document.

10.6.18 With regard to groundwater effects (i.e. quantity/quality), it is considered that the impact on groundwater during operation will be **negligible**.

10.7 Scope for Additional Mitigation Measures

10.7.1 There is no requirement for additional water resources mitigation measures other than the use of

the swales, attenuation basins, an infiltration basin and permeable paving outlined in the FRA and SuDS Strategy (**Volume 4, Appendix D**) and those requirements of the CoCP and CEMP listed above (for example, following CIRIA guidance on the management of water quality and surface water runoff during construction projects and the inclusion of a construction phase Soil Management Plan).

10.8 Residual Effects

10.8.1 **Table 10.6** provides a summary of the residual effects resulting from the Proposed Development after effective implementation of the embedded mitigation measures proposed above.

Table 10.6: Significant Residual Effects

Phase	Resource or Receptor affected	Likely Significance of Residual Effect with respect to flood risk and water quality
Construction	Surface water flow pathway (and associated downstream watercourses)	Negligible
	Thames Water Foul Water sewer	Negligible
	Groundwater – Principal Aquifer	Negligible
	Groundwater – Secondary (A) Aquifer (Thames Valley Formation)	Negligible
	Groundwater – Secondary (A) Aquifer (Lambeth Group)	Negligible
	Private licensed abstraction (SU77/166)	Negligible
Operation	Surface water flow pathway (and associated downstream watercourses)	Negligible
	Thames Water Foul Water sewer	Negligible
	Groundwater – Principal Aquifer	Negligible
	Groundwater – Secondary (A) Aquifer (Thames Valley Formation)	Negligible
	Groundwater – Secondary (A) Aquifer (Lambeth Group)	Negligible

10.9 Cumulative Effects

10.9.1 Cumulative effects are the combined effects of several development schemes (in conjunction with the Proposed Development) which may, on an individual basis be insignificant but, cumulatively, have a significant effect.

10.9.2 The ES has given consideration to 'Cumulative Effects' for schemes within 1 km as well as schemes located beyond 1 km radius from the boundary of the Site due to their size as outlined in **Table 3.8 of Volume 2 Chapter 3: EIA Methodology**. The five schemes to consider as part of the cumulative effects assessment are detailed below:

- SSE, Vastern Road, Ref: 190451 (2.66 km from the Site) involving demolition of a number of structures on the site and the erection of a new residential scheme (up to 210 units), with a maximum height of 11 storeys (up to 36m above ground level);
- Broad Street Mall, Broad Street, Reading, RG1 7QG, Ref: 182137 (3.43 km from the site) involving the construction of three residential buildings, construction of a 16 storey building on South Court comprising ground and first floor retail and creation of ground floor retail units;
- 199-203 Henley Road and land to the Rear of 205-207 Henley Road, Caversham, Reading, RG4 6LJ, Ref: 190835 (2.04km from the site) involving the demolition of 199-203 Henley Road and erection of part four, part three and part two storey 82 unit residential care home building; and
- St Martins Precinct, Church Street, Reading, Ref: 140997. Application involving redevelopment for retail, restaurant, leisure and residential (40 dwellings).

10.9.3 Given the permeability of the superficial deposits, new nearby developments could impede groundwater flows, although the extent of impedance is also a function of distance between the developments and there are no cumulative schemes immediately adjacent to the Site (all proposed developments are over 2 km from the Site). Given this and the potential for attenuation and dilution of pollutants, it is considered that there are no significant cumulative effects from the other nearby developments which would present significant risks to identified receptors. In addition, as it is considered that the Proposed Development would have a negligible impact on groundwater, the scheme will not lead to a cumulative impact in its own right.

10.9.4 The four schemes listed above are considered 'brownfield' redevelopment and would not, therefore, result in an increase in additional impermeable area. When combined with the Proposed Development, these schemes would not result in an increase in surface water flood risk.

10.9.5 Any new developments in the vicinity of the site would be subject to local and national policy (outlined in Section 10.2). Under these policies and legislations, the schemes would be required to demonstrate that there would be no detriment to water quality and WFD status/potential and no increased flood risk to the site or elsewhere. Without demonstrating compliance, either planning permission would not be granted, and construction cannot commence, or the prospective scheme would not reach the operational phase (if already constructed).

10.10 Summary and Conclusions

There may be a potential temporary detrimental impact on the water environment during the construction phase of the Proposed Development, particularly in relation to the release/erosion of sediment and soil, potential contamination from hydrocarbons/other chemical use, and through construction phase surface water runoff.

The local water environment may also be affected by the remobilisation of fertiliser, pesticide and herbicide residues present within soils which are stored during the construction phase. Good water management practice implemented through a Code of Construction Practice (CoCP) will minimise this impact. This will be delivered through a Construction Environmental Management Plan (CEMP), which will adhere to industry best practice measures, for example, CIRIA guidance on the management of water quality and surface water runoff during construction projects. The CEMP will also include a Soil Management Plan (SMP) to ensure that excavated soil is sustainably managed and does not present a pollution or flood risk to the surrounding water environment.

The management of surface water during the construction phase will require the early construction of the four infiltration basins that would ensure sustainable management of runoff during the operational phase. Measures implemented in the CoCP, CEMP and SMP will ensure that contaminated runoff does not reach these infiltration basins during construction activities.

During the operational phase, the development of the site will lead to an increase in the volume and rate of surface water runoff generated. Surface water attenuation measures will be required in order to prevent an increase in flood risk elsewhere. This is discussed further in the SuDS Strategy (**Volume 4, Appendix D**). The SuDS Strategy for the site will also need to be agreed in advance by the LLFA, which is likely to undertake the long-term adoption and maintenance of the proposed SuDS features.

The potential for operational-phase contamination of the surrounding water environment is relatively low, given that the proposed land use will be largely residential. The main operational-phase pollution risks, therefore, are associated with hydrocarbons from fuel/oil leaks from vehicles, and dust and sediment loading of surface water runoff. The detailed design of the proposed SuDS features will ensure that the potential for contamination of the water environment from these sources will be negligible.

With the proposed CoCP/CEMP, SMP and SuDS Strategy in place, the Proposed Development will not result in any significant effects during the construction or operational phases.

Table 10.7 summarises the topic effects resulting from the Proposed Development.

Table 10.7: Summary of Mitigation and Residual Effects

Receptor/ Affected Group	Value or Sensitivity of Receptor	Activity or Impact	Embedded Design Mitigation	Magnitude/ Spatial Extent/ Duration/ Likelihood of Occurrence	Significance of Effect	Additional Mitigation	Residual Magnitude of Impact	Significance of Residual Effect
Construction								
Surface water flow pathway (and associated downstream watercourses)	Low	Discharge of construction phase surface water/potential contamination	Management through CoCP/use of operational phase infiltration basins	Minor Direct Local Short Term Likely	Negligible	None	Negligible	Negligible
Thames Water foul sewer	Low	Scheme construction	Sewer diversion	Moderate Direct Local Short Term Likely	Negligible	None	Negligible	Negligible
Groundwater – Principal Aquifer	Low	Reduced infiltration/potential contamination	Management through CoCP/use of operational phase infiltration basins	Minor Indirect Local Short Term Likely	Negligible	None	Negligible	Negligible
Groundwater – Secondary (A) Aquifer (Thames Valley Formation)	Low	Reduced infiltration/potential contamination	As above	Minor Indirect Local Short Term Likely	Negligible	None	Negligible	Negligible
Groundwater – Secondary (A) Aquifer (Lambeth Group)	Low	Reduced infiltration/potential contamination	As above	Minor Indirect Local Short Term Likely	Negligible	None	Negligible	Negligible

Receptor/ Affected Group	Value or Sensitivity of Receptor	Activity or Impact	Embedded Design Mitigation	Magnitude/ Spatial Extent/ Duration/ Likelihood of Occurrence	Significance of Effect	Additional Mitigation	Residual Magnitude of Impact	Significance of Residual Effect
Operation								
Surface water flow pathway (and associated downstream watercourses)	Low	Increased flood risk/water quality impacts	SuDS Strategy	Moderate Direct Local Permanent Likely	Negligible	None	Negligible	Negligible
Groundwater – Principal Aquifer	Low	Reduced infiltration/water quality impacts	SuDS Strategy	Negligible Indirect Local Permanent Likely	Negligible	None	Negligible	Negligible
Groundwater – Secondary (A) Aquifer (Thames Valley Formation)	Low	Reduced infiltration/water quality impacts	SuDS Strategy	Negligible Indirect Local Permanent Likely	Negligible	None	Negligible	Negligible
Groundwater – Secondary (A) Aquifer (Lambeth Group)	Low	Reduced infiltration/water quality impacts	SuDS Strategy	Negligible Indirect Local Permanent Likely	Negligible	None	Negligible	Negligible
Site Drainage System (Flood risk)	Low	Flooding of properties on site	SuDS Strategy	Negligible Direct Local Permanent Likely	Negligible	None	Negligible	Negligible
Cumulative effects – Construction and Operation None.								