Chapter L
Water Environment and Drainage

Milton Keynes East Environmental Statement

Chapter L: Water Environment and Drainage

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Contents

L1.0 Introduction

L1.1 This chapter forms part of the Milton Keynes East Environmental Statement ('ES') which sets out the findings of an Environmental Impact Assessment ('EIA') of the proposed development of a sustainable urban extension to Milton Keynes. It relates to land to the east of the M1 motorway and to the south of Newport Pagnell. A description of the background to the proposal; the relationship of this chapter to the wider ES; and a description of the site and the development is provided at Chapters A to C of this ES.

L1.2 This chapter assesses the likely significant effects of the Proposed Development at Milton Keynes East (MKE) on the water environment in the context of the baseline conditions at and within the vicinity of the Development Site. Where appropriate it also identifies proposed mitigation measures to prevent, minimise or control likely negative (adverse) effects in terms of water resources, flood risk and drainage arising from the Proposed Development and the subsequent anticipated residual effects.

L1.3 This chapter should be read together with the introductory sections of this ES (Chapters A–C), as well as Chapter G 'Ecology' and Chapter I 'Ground conditions and soils' and the following technical appendices (Volume 2 to this ES):-

- Appendix L1 - Flood Risk Assessment (FRA)
- Appendix L2 -Surface Water Strategy (SWS)
- Appendix L3 - WFD Assessment; and
- Appendix l4 - HEWRAT Assessment.

About the Author

L1.4 WSP UK Ltd (WSP) has prepared the Water Environment and Drainage Chapter of the ES, which is accompanied by a Flood Risk Assessment (including hydraulic modelling), Water Framework Directive Assessment and a Surface Water Drainage Strategy. This assesses the likely effects of the Proposed Development on the water environment.

L1.5 WSP have a wide and extensive experience in preparing Water Environment ES impacts and the supporting evidence base, for a wide range of scenarios, including residential development. The lead author is Andy Smith BSc, MSc, C.WEM, CENV. Andy has over sixteen years' experience in the assessment of developments on the water environment and has prepared ES chapters for large development schemes, including North East Cardiff, Somerdale, Hull Eco Park and A1 Birtley to Coalhouse.

L2.0 Policy Context

Planning Policy Context

L2.1 Key planning policies are listed below.

National Policy Framework (NPPF) Ref 1

1 Section 10: Meeting the challenge of climate change, flooding and coastal change; and

2 Section 11: Conserving and enhancing the natural environment.

National Planning Practise Guidance (NPPG) Ref 2

3 Flood Risk and Coastal Change;

4 Water Supply, Wastewater and Water Quality;

5 Climate Change; and

6 Natural Environment.

Plan:MK 2016 – 2031, Adopted March 2019 Ref 3

7 Policy FR1: Managing Flood Risk;

8 Policy FR2: Sustainable Drainage Systems (SUDS) and Integrated Flood Risk Management;

9 Policy FR3: Protecting and Enhancing Watercourses;

10 Policy NE1: Protection of Site;

11 Policy NE4: Green Infrastructure; and

12 Policy SD12: Milton Keynes East Strategic Urban Extension.

Milton Keynes East Strategic Urban Extension Development Framework Ref 4

13 Supplementary Planning Document

Milton Keynes Strategy for 2050 Ref 5

14 Chapter Three – A Sustainable and Green City

Legislative Context

L2.2 The applicable legislative framework is summarised as follows:

1 The Environmental Protection Act 1990 Ref 6

2 The Water Industry Act 1991 Ref 7

3 Water Resources Act 1991 Ref 8

4 Land Drainage Act 1991 Ref 9

5 Land Drainage Act 1994 Ref 10

6 The Environment Act 1995 Ref 11

7 The Anti-Pollution Works Regulations 1999 Ref 12

8 The Water Industry Act 1999 Ref 13

9 The Water Act 2003 Ref 14

10 The Water Environment (Water Framework Directive) (WFD) (England and Wales) Regulations, 2003 (WFD) (2000/60/EC) Ref 15

11 The Floods Directive (2007/60/EC) Ref 16

12 The Flood Risk Regulations 2009 Ref 17

13 The Water Resources Act (Amendment) 2009 Ref 18

14 The Environmental Permitting (England and Wales) Regulations 2010 Ref 19

15 The Flood and Water Management Act 2010 Ref 20

16 The Water Act 2014 Ref 21

17 Infrastructure Act and Highways England License, 2015 Ref 22

18 Environmental Damage (Prevention and Remediation) (England) Regulations 2015 Ref 23

19 The Water Environment (Water Framework Directive) (England and Wales) (Amendment) Regulations 2017 Ref 24

20 Environmental Permitting (England and Wales) (Amendment) (No. 110) Regulations 2018 Ref 25

L3.0 Assessment Methodology & Significance Criteria

Assessment Methodology

L3.1 This section has assessed the Proposed Development based on the land use class, floorspace quantum and description of development as included in Chapter C of this ES 'Site and Scheme Description'.

L3.2 The study area considered for the purpose of this assessment will comprise the Proposed Development site and surrounding area within 250m. This distance has been used based on professional judgement in general practice and it is considered that within this radius the surrounding area may be affected by or may affect the Development Site. This distance is extended up to 1.5km downstream (northwest) from the Development Site boundary when considering potential effects on flood risk to downstream communities.

L3.3 All aspects of the Proposed Development are relevant to this section as the proposals will entail an increase in the number of users of the Development Site which may affect flood risk, water supply quantity and discharged water quality and quantity from the Development Site.

L3.4 This assessment has been undertaken through a combination of consultation / meetings (see section L3.18), hydraulic modelling, site visits and desk based assessments, full details are provided in the relevant appendices and summarised in the Baseline Conditions section of this chapter (section L4.0).

L3.5 Possible significant effects on the quality of surface water and groundwater bodies within the Study Area have been identified, as well as possible changes in flood risk at the Development Site and downstream as a result of the development.

Significance Criteria

L3.6 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 B of this ES – Scope and Methodology.

L3.7 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 large, medium, small and negligible.

L3.8 Magnitude of change and the sensitivity of the affected receptor/receiving environment have been assessed adapting the relevant tables within the following documents:

1 Design Manual for Roads and Bridges (DMRB) Road Drainage and the Water Environment (LA 113 Revision 1). The DMRB provides guidance for appraising significance on potential effects that road projects may have on the water environment [Ref 35]; and

2 TAG Unit A3 Environmental Impact Appraisal – Impacts on the Water Environment chapter [Ref 36].

L3.9 Although the above two documents were developed to provide guidance for assessing potential effects that road projects may have on the water environment, they provide a general framework which can be used to provide a consistent assessment of the effects of development proposals on the water environment.

L3.10 For the purposes of this Chapter, the term 'sensitivity' has been used rather than value or importance of receptor as outlined in the DMRB guidance.

L3.11 Table L3.1 outlines the criteria used to assess the sensitivity of receptors as part of this assessment.

Table L3.1 Classification of sensitivity of water receptors

Sensitivity	Criteria	Examples
High	An attribute with high quality and rarity, regional or national scale and limited potential for substitution.	Principal Aquifer providing potable water to a large population (groundwater). Water Framework Directive (WFD) 'High' status water body or acting as a potable water supply. Human health receptors (including construction workers and future Site users). Existing water supply or wastewater network with no availability/ capacity. Designated site or species protected under EU or UK habitat legislation, such as Sites of Special Scientific Interest ('SSSI'), Special Areas of Conservation ('SAC'), and Special Protection Areas ('SPA'), hydrologically linked to the Development Site
Medium	An attribute with medium quality and rarity, regional or national scale and limited potential for substitution.	WFD 'Good' status water body. Aquifer providing abstraction water for agricultural or industrial use (ground water). Existing water supply or wastewater network with limited availability/ capacity. Locally designated site (Local Nature Reserve) considered to be directly supporting or maintaining water conditions hydrologically linked to the Development Site
Low	An attribute with low quality and rarity, regional or national scale and limited potential for substitution.	WFD less than 'Good' status water body. Unproductive strata (ground water). Heavily managed river and floodplain. Existing water supply or wastewater network with availability/ capacity.
Negligible	An attribute with limited quality and rarity, local scale and potential for substitution.	Very minor river or drain of limited quality. Channelised river and floodplain, providing no flood storage capacity. Existing water supply or wastewater network with large availability/ capacity.

L3.12 The criteria for determining the magnitude of change / effect is detailed in Table L3.2.

L3.13 For flood risk in relation to construction workers and future users / residents of the development, magnitude of effect rather than change is considered as those receptors are currently not affected and therefore 'change' is not applicable.

Table 3.2 Magnitude of change/effect criteria

Magnitude	Criteria	Examples
High	Results in a loss or major improvement of feature.	Significant fluvial flooding affecting offsite receptors caused or severely exacerbated by the Proposed Development has a high probability of occurring (i.e. exceeding 1% annual probability) with potential high depth / velocity of water and risk to life and/or major financial effect. Vice-versa the Proposed Development

Magnitude	Criteria	Examples
		might significantly reduce or eliminate flooding for events with a high probability of occurring. Significant flooding which could potentially cause detrimental consequences at the Development Site including the loss of life and that has a high probability of occurring (i.e. exceeding 1% annual probability). Significant increase / reduction in the flow entering controlled systems causing a major change in the probability/magnitude of flooding. Change in WFD classification of river reach. Impact capable of causing extensive changes to local hydrography and flow paths. Impact capable of causing a major reduction in sewerage/public water supply network capacity.
Medium	Results in a medium change on the integrity or improvement of a feature or loss or gain of part of a feature.	Flooding which could potentially cause financial effect and disruption offsite, caused or exacerbated by the Proposed Development, has a high probability of occurring (i.e. exceeding 1% annual probability). Flooding of the Development Site which could cause financial effect and disruption (but no loss of life) has a high probability of occurring (i.e. exceeding 1% annual probability). Increase / reduction of amount of flow entering controlled systems (Sufficient enough to cause a noticeable change in the probability / magnitude of flooding). Impact capable of causing limited and, localised change in local hydrography and flow paths. Impact capable of causing some contribution or reduction of pollution entering feature, but insufficient to change WFD classification;
Low	Results in a minimal change in the integrity of the feature or loss of part of a feature.	Small increase / decrease in the likelihood of flooding as a consequence of the Proposed Development. Limited increase in sediment entering controlled water systems. Limited increase / reduction of amount of flow entering controlled systems which would cause a small / barely noticeable change in the likelihood of flooding. Impact capable of causing a localised and minor change in local hydrography and flow paths.
Negligible	Results in a change but the change is marginal and is unlikely to be noticeable	The Proposed Development is unlikely to affect the integrity of the water environment and / or change the risk of flooding.
No Change	No loss or alteration of characteristics, features or elements; no observable impact in either direction.	

L3.14 Both sensitivity of the receptors value and magnitude of change must be considered when determining the significance of effect. In the same manner as the assessment of the magnitude of change and the sensitivity of the affected receptor/receiving environment; the significance of effect has been assessed by adapting the relevant table within the following documents:

1 DMRB Environmental Assessment and Monitoring (LA 104 Revision 1). This chapter of the DMRB provides guidance for undertaking environmental assessments for road projects [Ref 35]; and

2 TAG Unit A3 Environmental Impact Appraisal – Impacts on the Water Environment chapter [Ref 36].

L3.15 A summary of the significance matrix can be found in Table L3.3.

Table L3.3 Magnitude of change/effect criteria

Sensitivity	Magnitude of impact/change				
	No Change	**Negligible**	**Low**	**Medium**	**High**
Negligible	Neutral	Negligible or Neutral	Negligible or Minor	Negligible or Minor	Minor
Low	Neutral	Negligible or Minor	Negligible or Minor	Minor	Minor or Moderate
Medium	Neutral	Negligible or Minor	Minor	Moderate	Moderate or Substantial
High	Neutral	Minor	Minor or Moderate	Moderate or Substantial	Substantial

L3.16 Effects/changes that are described as 'substantial', or 'moderate' are determined to be significant; and effects that are described as 'minor', 'negligible' or 'neutral' are determined to be not significant in the context of the EIA Regulations.

L3.17 Effects may be classified as either beneficial or adverse.

Consultation

L3.18 The Environment Agency and Milton Keynes Council (as the Lead Local Flood Authority - LLFA) were contacted as statutory consultees to request their scoping opinion for the proposed MKE development.

L3.19 Milton Keynes Council provided their scoping opinion response on the 3rd of November 2020 (See Appendix B2, Volume 2 to this ES) in which they stated that the principles of surface water drainage outlined within the scoping report were acceptable and that they expected a full Flood Risk Assessment (FRA) and surface water drainage strategy (SWS) to be submitted.

L3.20 The Environment Agency provided their scoping response on the 29th of October 2020 stating that they agree with the assessments that are being undertaken (See Appendix B2, Volume 2 to this ES).

L3.21 WSP have also been in consultation with the Environment Agency regarding:

1 The hydraulic modelling of the River Ouzel and Moulsoe Stream, with further details of the consultation between WSP and the EA on these matters included in the FRA (Appendix L1, Volume 2 to this ES) which includes the Hydraulic Modelling Report (HMR).

2 The screening and scoping of the Water Framework Directive Assessment, with further details of the consultation between WSP and the EA on this matter included in the Water Framework Directive Assessment (Appendix L3, Volume 2 to this ES).

L3.22 WSP have also been in consultation with the Bedford Group of Internal Drainage Boards (the IDB) regarding the SWS and the IDB designated watercourses within the Development Site extents with further details of the consultation between WSP and the IDB on this matter included in the FRA (Appendix L1, Volume 2 to this ES).

L3.23 WSP have also been in consultation with Milton Keynes Council regarding surface water flood risk, the SWS, private water supplies (it was confirmed that there are none within the Development Site extents or its vicinity) and the emergency planning implications associated with the development with further details of the consultation between WSP and Milton Keynes Council on this matter included in the FRA (Appendix L1, Volume 2 to this ES).

Assumptions and Limitations

L3.24 The following impacts were identified as insignificant within the EIA scoping report and therefore have not been included in this assessment:

L3.25 The site is not at risk from tidal flooding and therefore this will not be considered further within the ES;

L3.26 The Study Area is not located within or adjacent to a groundwater Source Protection Zone . As such, no significant effects on public drinking water supplies are anticipated and will not be considered further within the ES; and

L3.27 The surface water runoff from the parts of the Development Site for which development is proposed will not impact the groundwater regime in the area, and will not be considered further within the ES; and

L3.28 In terms of potable water supply and foul water treatment the demands associated with the development would be provided within the current permits and headroom capacity associated with the Anglian Water infrastructure and therefore these matters will not be further assessed.

L3.29 The potential impacts as a result of the Scheme on the quarry at Land South of Caldecote Farm (which is located to the immediate north west of the Scheme) or to the Scheme as a result of the cessation of any dewatering which is / was being undertaken as part of the operation of quarry have been scoped out of further assessment within this ES Chapter. This is because it is understood that the mineral extraction phases is completed (or will be imminently). Furthermore, the Flood Risk Assessment for the quarry (planning reference: 11/01477/MIN) outlined that mitigation measures are to be in place to maintain the flow in the ditches (located between the Scheme and the quarry) and maintain the status of the water regime in the area adjacent to the extraction site, both during and after extraction, therefore no change in the groundwater levels on the site are predicted.

L4.0 Baseline Conditions

Baseline Data Collection

L4.1 The baseline information presented in this chapter has been informed by the following methods:

Desk Study

L4.2 The following sources of information have been reviewed as part of the desk study:

1 The Environment Agency's Long-Term Flood Risk Maps [Ref 26];

2 The Environment Agency's Flood Map for Planning [Ref 26];

3 The Environment Agency's Catchment Data Explorer [Ref 27];

4 British Geological Survey (BGS) geological mapping [Ref 28];

5 National Soil Maps [Ref 29];

6 Natural England designated sites database [Ref 30];

7 Magic Maps natural environment database & mapping [Ref 42];

8 Topographical survey of the Development Site, and

9 All relevant legislation noted in Section L2.0.

Site Visit / Other Assessments

L4.3 A site walkover was conducted in January 2020 by representatives of the WSP team undertaking this Water Environment Chapter.

L4.4 The WSP reports provided as Appendix L1 to L4 (Volume 2 of this ES) have been prepared for the Proposed Development and used to inform this assessment.

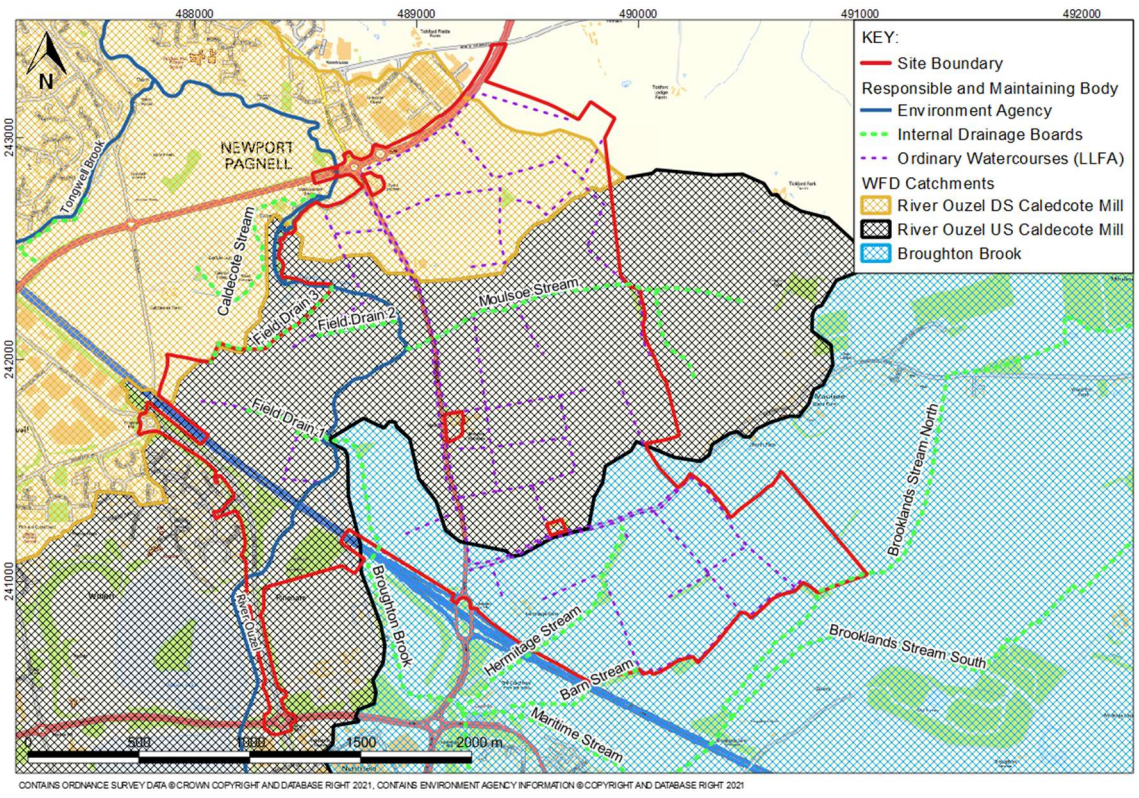
Existing Conditions

L4.5 The current conditions at the Development Site have been informed by a desk study using available information such as Environment Agency flood mapping and by a site visit carried out by WSP staff in January 2020.

Surface Water Bodies

L4.6 Several surface water features are located within or in proximity to the Development Site, including watercourses, ponds and culverts. The locations of these surface water features are shown in Figure L4.1.

Figure L4.1 Surface Water Bodies



River Ouzel

L4.7 The River Ouzel rises in the Chiltern Hills southeast of the Proposed Development near the village of Dagnall. The river flows northeast through the settlements of Leighton Buzzard and Bletchley before turning to flow north through Milton Keynes and under junction 14 of the M1 motorway just west of the Development Site. Downstream of the Development Site the Ouzel flows north towards its confluence with the River Great Ouse in Newport Pagnell.

L4.8 In its reaches by the Development Site the River Ouzel is classified as a Main River and therefore its associated flood risk is overseen by the Environment Agency. The Environment Agency manages three gauging stations along the River Ouzel, located at Leighton Buzzard (NRFA Reference 33057), Bletchley (NRFA Reference 33058) and Willen Lake (NRFA Reference 33015). The mean discharge of the Ouzel is 0.80m^3/s at Leighton Buzzard, 1.79m^3/s at Bletchley, and 2.01m^3/s at Willen.

L4.9 There are a number of flood alleviation ponds within Milton Keynes (the nearest of which is Willen Lake) which are managed by Anglian Water which impact the flows conveyed by the River Ouzel.

L4.10 The Environment Agency's Catchment Data Explorer shows the current ecological status of the River Ouzel upstream Caldecote Mill (GB105033037971) to be Moderate, whilst the current chemical status of the river is assessed to be failing. The River Ouzel upstream of Caldecote Mill is designated as a heavily modified watercourse. This designation covers the channel of the River Ouzel throughout the Development Site.

L4.11 Within the north of the Development Site, parts of the wider catchment of the River Ouzel become designated under the Ouzel downstream of Caldecote Mill catchment (GB105033037972), however the ecological and chemical statuses remain the same as the

upstream catchment. Downstream of Caldecote Mill the River Ouzel is not designated as an artificial or heavily modified watercourse.

Broughton Brook

L4.12 The Broughton Brook is a tributary of the River Ouzel that rises southeast of the Proposed Development on the outskirts of Woburn. The Broughton Brook flows north through Husborne Crawley towards Junction 13 of the M1 before turning to flow west along the M1 where it joins the River Ouzel just north of Junction 14.

L4.13 The Environment Agency's Catchment Data Explorer shows the current ecological status of the Broughton Brook (GB105033037930) to be Poor, whilst the current chemical status of the river is assessed to be failing. The Broughton Brook is designated as a heavily modified watercourse and in its reaches past the Development Site the Broughton Brook is a designated watercourse which is managed by the IDB.

L4.14 The Environment Agency operate a gauging station on the Broughton Brook at Broughton (NRFA Reference 33031), with the mean flow measured at this gauge found to be 0.32m^3/s.

Broughton Brook Tributaries

L4.15 In the southeast of the Development Site there are three IDB designated watercourses that are tributaries of the Broughton Brook. All of these watercourses are considered a part of the Broughton Brook catchment under the Water Framework Directive. These are considered to be small ephemeral field drainage ditches.

L4.16 The Hermitage Stream rises to the south of Newport Road before flowing southwest towards the M1 Motorway where it passes through a culvert before discharging to the Broughton Brook adjacent to Milton Keynes Coachway.

L4.17 The Barn stream is small field drain which runs along the southern boundary of the Development Site before being culverted under the M1. It discharged to the Broughton Brook via the Maritime Stream, which is another IDB designated watercourse.

L4.18 The Brooklands Stream North rises to the east of the Proposed Development near Cranfield before flowing west towards Moulsoe and then south towards the M1. The Brooklands Stream North skirts along the Development Site boundary in the easternmost corner of the Development Site. The Brooklands Stream North flows meets the Brooklands Stream south near the village of Broughton before passing under the M1 in a culvert. The Brooklands Stream discharges into the Maritime Stream which then outfalls into the Broughton Brook.

Moulsoe Stream

L4.19 The Moulsoe Stream is an ephemeral tributary of the River Ouzel that rises to the east of the Proposed Development on the edge of the village of Moulsoe. The Moulsoe stream flows from east to west through the Proposed Development, before being culverted under the A509 (London Road) and discharging into the River Ouzel in the centre of the Development Site.

L4.20 The Moulsoe Stream is a designated watercourse which is managed by the IDB.

L4.21 The Moulsoe Stream has not been classified under the Water Framework Directive and is considered a part of the Ouzel Upstream of Caldecote Mill catchment.

Field Drains 1-3

L4.22 In the northwest of the Development Site there are three field drains that are designated as watercourses under the jurisdiction of the IDB. These are considered to be small ephemeral field drainage ditches.

L4.23 These field drains all flow from west to east and discharge into the River Ouzel and fall within the River Ouzel Upstream of Caldecote Mill Catchment.

WFD Classifications

L4.24 Table L4.1 displays the classifications of the WFD features under cycle 2 (2019).

Table 4.1 Classification of Water Framework directive features (2019 Cycle 2) within and in vicinity of the Development Site

Surface Water Feature	Approx. Distance	Direction	WFD RBMP Chemical Classification	WFD RMBP Ecological Classification	Overall Water Body Status
Broughton Brook	Through the south of the site	North to south	Fail	Poor	Poor
Ouzel US Caldecote Mill	Through the west of the site	North to South	Fail	Moderate	Moderate
Ouzel DS Caldecote Mill	Through the north of the site	North to South	Fail	Moderate	Moderate

Groundwater

L4.25 The geology underlying the Development Site is presented in Chapter I 'Ground Conditions & Soils' of the Environmental Statement. The site's geology is predominately made up of Mudstone from the Peterborough Member and Stewartby Member but an area of Sandstone and Silestone bedrock from the Kellaways formation is also found to the west of the Development Site.

L4.26 Superficial Alluvial and Head deposits that consist mainly of sand, gravel, silt and clay are associated with floodplains within the study area.

L4.27 Of relevance to groundwater, the superficial head and alluvial deposits are classified as Secondary A Aquifer, and the bedrock to the west of the Development Site is classified as a secondary A aquifer. The 2015 Strategic Flood Risk Assessment for Milton Keynes states that there is surface water-groundwater interaction within superficial aquifers along the River Ouzel and its tributaries.

L4.28 Groundwater monitoring was undertaken at the Development Site in August – September 2020 by CC Ground Investigations Ltd. Across a series of boreholes on the western floodplain of the River Ouzel (close to field drain 2), groundwater was encountered at depths of between 0.5mbgl and 3.2mbgl. These groundwater levels are at/around same level as River Ouzel water level. It is expected that in winter that these groundwater levels may be higher.

L4.29 The site is not situated within a designated groundwater catchment or a groundwater Source Protection Zone (SPZ) as defined by the Environment Agency.

L4.30 There are no designated Groundwater Dependent Terrestrial Ecosystems (GWDTE) within the Development Site.

L4.31 The ecological appraisal undertaken for the Development Site did not identify any exceptional GWDTEs on site such as significant flushes or springs. Aside from the onsite watercourses, the main wetland habitats that were identified to have an element of groundwater reliance were:

1 Damp low lying grassland, along the River Ouzel corridor, next to field drains 2 and 3. The ecological appraisal found that the species composition of this grassland is broadly characteristic of NVC Classification MG4. Guidance from the UKTAG Wetland Tasks Team [Ref 31] states that NVC community MG4 has a moderate dependence on groundwater.

2 Damp low lying woodland area to the east of the A509 (London Road), approximately 300m northeast of the confluence of the Moulsoe Stream and the River Ouzel. This area includes wet woodland and wet hollows.

3 A number of ponds, ditches and drains across the Development Site.

L4.32 None of these habitats that have an element of groundwater reliance are subject to any international, national, regional or local designations so are be deemed to be of low importance and have a low sensitivity to potential changes in the groundwater regime, as such no further assessment is required.

Flood Risk

L4.33 As discussed in the FRA (Appendix L1, Volume 2 to this ES), parts of the Development Site are shown to be at risk from fluvial and surface water and fluvial flooding, this is described below.

Fluvial Flooding

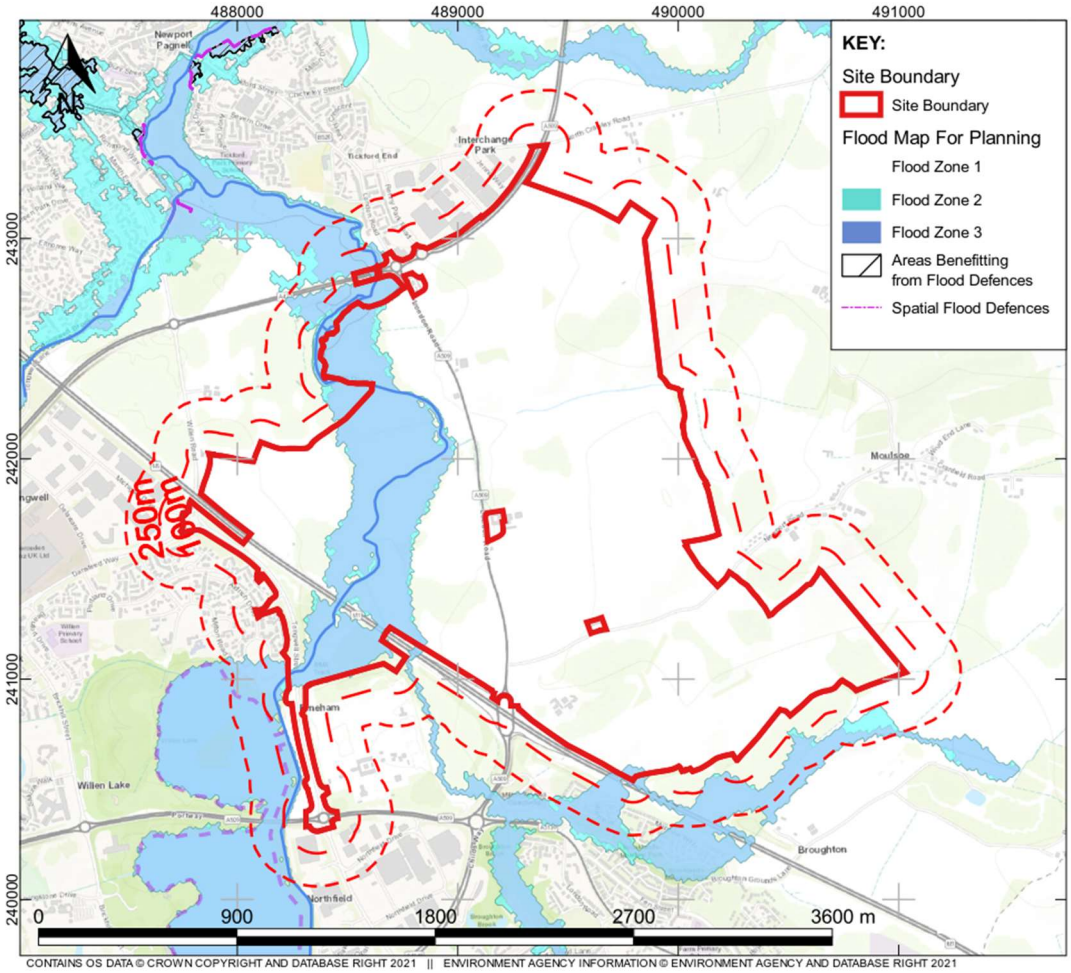
L4.34 With respect to fluvial flooding, the Environment Agency's Flood Map for Planning shows land adjacent to the Broughton Brook and the River Ouzel within the Development Site boundary to be within Flood Zones 2 and 3 (as shown in Figure L4.2). Flood Zone 3 is defined as land having a greater than 1 in 100 annual probability of fluvial flooding, with Flood Zone 2 defined as land having between a 1 in 1000 and a 1 in 100 annual probability of fluvial flooding.

L4.35 WSP have undertaken hydraulic modelling of the River Ouzel and Broughton Brook to refine the modelling undertaken by the Environment Agency as a part of 2011 Upper Great Ouse Flood Hazard Mapping Study.

L4.36 The baseline Hydraulic Modelling Report, included as an appendix to the FRA (Appendix L1, Volume 2 to this ES) summarises the changes that were made to the Environment Agency's existing model of the River Ouzel.

L4.37 Modelled baseline fluvial flood extents for the 1 in 20 year, 1 in 100 year and 1 in 1000 year events are shown in Appendix L1 (Volume 2 to this ES). The baseline results show that a significant area in the west of the Development Site (approximately 10.2% of the total site area) is within the 1 in 20 year flood extent. The 1 in 20 year flood extent is defined as the functional floodplain.

Figure L4.2 Flood Map for Planning



L4.38 In the 1 in 20 year event, flood depths are expected to be below 0.5m for most of the Development Site, with depths of up to approximately 0.75m near the confluence of the River Ouzel and the Broughton Brook.

L4.39 The baseline 1 in 100 year flood extents (equivalent to Flood Zone 3 on the Flood Map for Planning) cover approximately 11.9% of the Development Site and the 1 in 1000 year flood extents (equivalent to Flood Zone 2 on the Flood Map for Planning) cover approximately 12.8% of the Development Site).

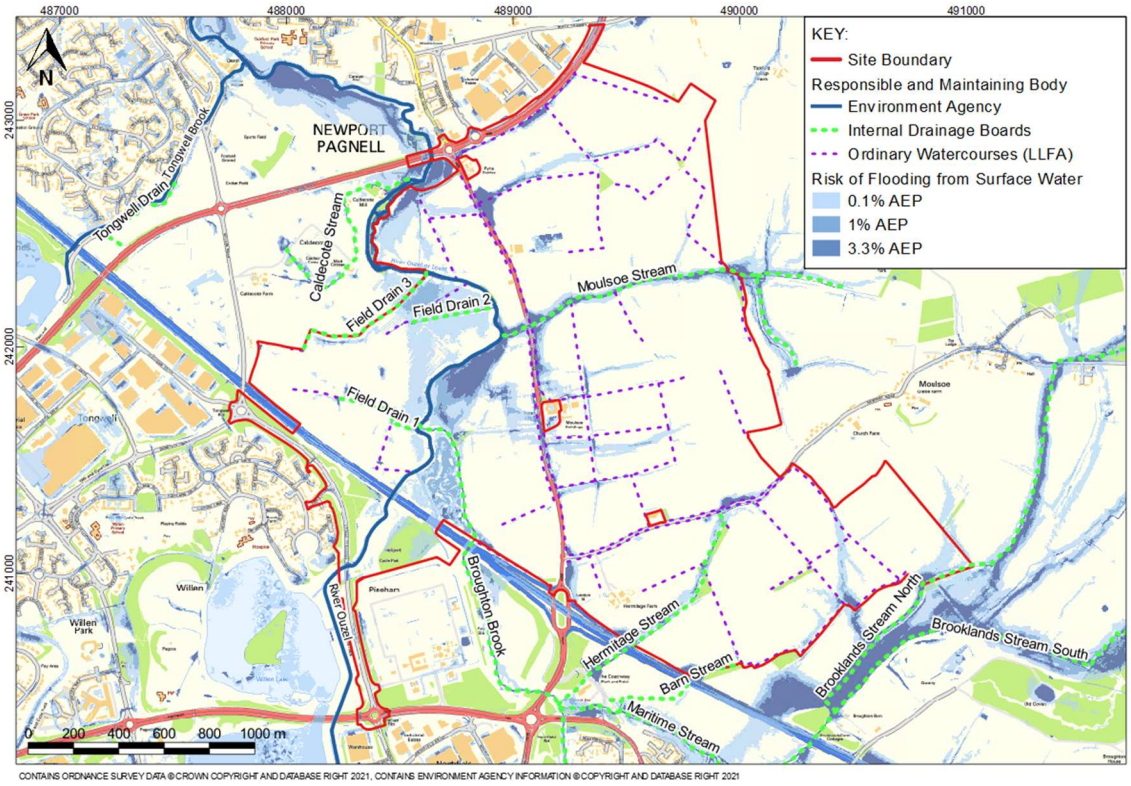
L4.40 In the 1 in 100 year event flood depths are expected to be below 0.7m across the majority of the Development Site with depths of up to 1.0m by the confluence of the Broughton Brook and River Ouzel.

L4.41 In the 1000 year event, flood depths are expected to be below 0.8m across most of the Development Site but depths of up to 1.2m are predicted by the confluence of the River Ouzel and Broughton Brook.

Surface Water Flooding

L4.42 Regarding surface water flooding, as shown in Figure L4.3 there are a number of surface water flow paths across the Development Site and for the most part these surface water flowpaths coincide with IDB watercourses and field drains.

Figure L4.3 Risk of Flooding from Surface Water



L4.43 Within the Development Site boundary there are high risk (>3.3% AEP) surface water flowpaths along the following IDB designated watercourses; the Moulsoe Stream; the Hermitage Stream; the Barn Stream and Brooklands Stream North.

L4.44 Adjacent to the River Ouzel and Field Drains 3 there in an area at medium risk (1.0% - 3.3%AEP) of surface water ponding.

L4.45 The land next to Field Drains 1 and 2 and the land to the east of the River Ouzel is shown to be at Low Risk (0.1% - 1.0% AEP) of surface water flooding.

L4.46 Hydraulic modelling of the surface water flooding associated with the Moulsoe Stream has been undertaken to refine the extents shown on the Environment Agency's Risk of Flooding from Surface Water mapping. Hydraulic modelling has not been undertaken for the other risk areas as the catchments are relatively small and contained within the Development Site boundary, thus will be altered and managed by the SWS.

L4.47 The baseline modelled flood extents for the Moulsoe Stream show that flows are largely contained within the extent of the channel for all events up to and including the 1 in 100 year +65% climate change scenario.

L4.48 The only notable flooding is as a result of high water levels modelled in the River Ouzel at the downstream extent which were extracted from the MKE River Ouzel flood model. These lead to flood extents that reach up the watercourse as far as the downstream end of the London Road culvert.

Future Baseline

L4.49 The most significant change in the baseline conditions is likely to be associated with climate change that could cause an increase in peak river flows and peak rainfall intensity. The UK Government provide guidance on a range of climate change allowances dependant on the river

basin district that the Development Site and watercourse is in. The site is located within the Anglian River Basin District. In this region, it is predicted that by 2080, peak river flows could increase by 25% (the central estimate), 35% (higher central estimate) and 65% (the upper end estimate). This could increase the probability of flooding at the Development Site and surrounding areas, as well as the proportion of the Development Site within Flood Zones 2 and 3.

L4.50 Increases in peak river flows have been incorporated into the hydraulic modelling of the River Ouzel, with flood extent and depth maps of the 1 in 100 year +35% (the design scenario) and 1 in 100 year +65% climate change (sensitivity scenario) events included as an appendix to the FRA (Appendix L1, Volume 2 to this ES).

L4.51 Under the higher central (+35%) climate change allowance scenario, the 1 in 100 year extents are expected to cover approximately 12.8 % of the Development Site, compared to 11.9% under the present day 1 in 100 year flood extents. Under the upper end (+65%) climate change allowance scenario, approximately 13.4% of the Development Site is expected to be within the 1 in 100 year flood extents.

L4.52 In addition to an expected increase in flood extents, minor increases in flood depths are predicted under the modelled 1 in 100 year +35% and 1 in 100 year +65% climate change scenarios, compared to the present day 1 in 100 year flood event.

L4.53 The guidance provided for peak rainfall intensity allowances predicts that by 2080, peak rainfall intensity could increase by between 20% (central estimate) and 40% (upper end estimate). This could increase the probability and depth of surface water flooding at the Development Site and the surrounding areas. A plus40% allowance has been incorporated into the SWS for the Development Site.

L4.54 As the Development Site is not located within a tidally influenced area there will be no change to predicted flood risk from the sea associated with seas level rise (as a result of climate change).

L4.55 Given the requirements within NPPF that there is to be no increase in risk to third parties as a result of any Scheme, no other developments in isolation or cumulative should change the baseline conditions in relation to flood risk.

L5.0 Potential Effects

Sensitive Receptors

L5.1 Table L5.1 outlines the sensitive receptors which have been assessed within this chapter.

Table L5.1 Summary of sensitive receptors

Feature	Sensitive Receptor	Location	Sensitivity / importance	Description
Surface Water Quality	River Ouzel	Flows from south to north through the west of the site	Low in relation to surface water quality	This waterbody has a 'Fail' WFD RBMP Chemical Classification, a Moderate RBMP Ecological Classification and an overall status of Moderate.
	Broughton Brook	Flows through the south of the site before discharging into the River Ouzel near the centre of the site.	Low in relation to surface water quality	This waterbody has a 'Fail' WFD RBMP Chemical Classification, a Poor RBMP Ecological Classification and an overall status of Poor.
	Moulsoe Stream	Onsite and discharges into River Ouzel	Negligible in relation to surface water quality	The Moulsoe stream discharges into the River Ouzel which has a moderate WFD RBMP Ecological Classification and a 'Fail' RMBP chemical classification.
Ground water Quality	Underlying aquifers (the superficial alluvium and head deposits associated with the floodplain of the River Ouzel and its tributaries are Secondary A aquifers; Peterborough Member and Kellaways Formation bedrock are classified as Secondary A Aquifers)	Onsite and offsite	Medium in relation to water quality	The underlying aquifers are classified as secondary aquifers.
Ground-Water Reliant Habitats	The ecological appraisal undertaken for the site identified several habitats that have an element of groundwater reliance.	Onsite and Offsite	Low	None of the identified habitats that have an element of groundwater reliance are subject to any international, national, regional or local designations
Flood Risk	Ground workers and construction workers	Onsite	Medium	Flooding may affect Construction workers, but their sensitivity is lowered as a result of a level of competence attained by construction workers through measures such as Health and Safety training

Feature	Sensitive Receptor	Location	Sensitivity / importance	Description
				and presence only during working hours in teams.
	Future populations onsite and users of the site	Onsite	High	Future Site users could be affected by flooding during the construction stage and after; sensitivity of future residents is the highest among future users of the Development Site due to their presence overnight (sleeping accommodation).
	Third parties offsite including offsite residents down gradient from the Proposed Development	Offsite	High	Residents/users of the surrounding areas might have limited or no awareness of flood risk; sensitivity of residents is the highest due to their presence overnight (sleeping accommodation).

During Construction

L5.2 The following possible significant effects that could occur during the construction of the Proposed Development have been identified:

1 Changes in the risk of surface water and fluvial flooding at the Development Site and their effects on potential receptors (i.e. construction workers);

2 Changes in groundwater flows during flood events as a result of the highway embankment that may impact the groundwater regime of the superficial aquifers;

3 Changes in the risk of surface water flooding on the surrounding areas and their effects on potential receptors (i.e. residents and users); and

4 Change to the quality (i.e. physical & chemical contamination) of surface water discharged to the water environment water environment.

Changes in the risk of surface water and fluvial flooding at the Development Site

L5.3 Surface water and fluvial flooding, especially after extreme rainfall events, has the potential to harm workers onsite if it is received in large volumes, particularly if they are working in the floodplain or in excavations, which have the potential to fill with water. In addition, construction of the Proposed Development will lead to the introduction of impervious surfaces and a potential reduction in permeable area through the temporary siting of the contractor's compound and storage areas. This would temporarily reduce infiltration, increase surface water runoff and potentially increase flood risk across the development site and in the surrounding area

L5.4 The topography of the Development Site will change during site preparation, earthworks and construction. The re-profiling of the land has the potential to change the rate and direction of surface water flows within the study area. Existing overland flowpaths could be diverted, terminated and new flowpaths could be created during construction. The placement/stockpiling of materials may also influence where surface water collects and flows. This has the potential to alter the rate and volume of water entering local watercourses and surface water features on and offsite, as well as the volume of water infiltrating through the soils into the underlying aquifer systems.

L5.5 During construction, the potential receptors of changes in surface water and fluvial flood risk at the Development Site are the construction workers

L5.6 The sensitivity of construction workers is considered to be medium, and the magnitude of change/effect prior to mitigation, is considered to be high.

Changes in groundwater flows during flood events as a result of the highway embankment that may impact the groundwater regime of the superficial aquifers

L5.7 The proposed Development lies on superficial head and alluvium deposits, consisting of clay, silt, sand and gravel which are classified as a Secondary A aquifer. Along the floodplain of the River Ouzel there is surface water – groundwater interaction within the superficial deposits / aquifers.

L5.8 The proposed crossing of the River Ouzel (Highway Link 107) during the first phase of development will form an embankment across the floodplain, however no piling is planned. Providing that the proposed embankment does not significantly interact with, or impact upon the aquifer then there is no prospect for any impact upon the groundwater regime.

L5.9 The sensitivity of the identified habitats that have an element of groundwater reliance such as the grassland to the west of the River Ouzel, is assessed to be Low. The magnitude of effect prior to mitigation is considered to be no change.

Changes in the risk of surface water flooding on the surrounding areas

L5.10 Existing overland flowpaths could be diverted, terminated and new flowpaths could be created during construction. The placement/stockpiling of materials may also influence where surface water collects and flows. This has the potential to alter the rate and volume of water entering local watercourses and surface water features offsite.

L5.11 The residents and users of the surrounding areas are further away from the Development Site than the construction workers and would therefore experience a lesser magnitude of change/effect compared to the construction workers. Whilst the residents and users of the initial phases of the buildings / areas constructed during the initial phases will experience a lesser magnitude of change/effect compared to the construction workers, as they will benefit from the early implementation of the relevant aspects of the SWS and flood mitigation measures.

L5.12 The sensitivity of the residents and users of the surrounding areas is considered to be high, and the magnitude of change prior to mitigation, is considered to be medium.

Change to the quality (i.e. physical & chemical contamination) of surface water discharged to the water environment

L5.13 There will be a number of activities during the construction of the Proposed Development that will disturb the ground and potentially result in increased sediment and pollutants in surface water runoff and subsequently the water environment.

L5.14 These activities include:

1 Movement and use of static and mobile plant/construction vehicles such as excavators. Dumper trucks, hydraulic breakers and haulage trucks;

2 Materials handling, storage, stockpiling, spillage and disposal;

3 Bulk earthworks to ground formation levels;

4 Construction of drainage features, and

5 Installation of infrastructure, roads and haul routes.

L5.15 These construction activities, in particular vehicle movements within the Development Site, will lead to the disturbance and mobilisation of physical contaminants, which may result in increased suspended sediment loads in surface waters, especially during periods of heavy rainfall. On the other hand, during periods of dry, windy weather, wind-blown dusts generated by ground excavation and earthworks may indirectly enter surface water bodies on and offsite. Elevated suspended sediment loads in surface waters could potentially lead to effects, such as increased turbidity and a reduction in dissolved oxygen, and subsequently a degradation in water quality.

L5.16 Additionally, surface water runoff from the construction site could potentially carry elevated concentrations of soluble contaminants and any accidental spillage of fuel, cement products or chemicals could enter surface waters within the study area. Soils associated with floodplains within the Development Site are identified to have slightly impeded drainage and therefore have a low to moderate leaching potential meaning any contaminated surface water runoff and/or spills of chemicals would be transmitted slowly to the underlying aquifer systems. These soluble contaminants could potentially alter the chemistry of the water environment and affect biodiversity of the waterbodies.

L5.17 The sensitivity of the River Ouzel, Broughton Brook, Moulsoe stream and other IDB watercourses is assessed to be low. The magnitude of effect prior to mitigation is assessed to be medium.

During Operation

L5.18 The following possible significant effects that could occur during operation have been identified:

1 Changes in the risk of surface water and fluvial flooding at the Development Site and their effects on potential receptors (i.e. residents and users);

2 Changes in risk of fluvial and surface water flooding on the surrounding area and their effects on potential receptors (i.e. residents and users);

3 Changes in groundwater flows during flood events as a result of the highway embankment that may impact the groundwater regime of the superficial aquifers;

4 Changes to the drainage regime – quantity and quality of surface water discharged to the water environment.

Changes in the risk of surface water and fluvial flooding at the Development Site

L5.19 As outlined in the FRA (Appendix L1, Volume 2 to this ES) several aspects of the development have the potential to impact the fluvial flood regime of the River Ouzel, such as the proposed River Ouzel Crossing (Highway Link 107) with a 30m bridge opening centred on the River Ouzel and the proposed widening of Tongwell Street bridge.

L5.20 These proposals have been incorporated into the post-development hydraulic modelling of the River Ouzel and Broughton Brook, to assess how they may impact on flood risk. Details of the post development flood modelling are included as an appendix to the FRA in Appendix L1 (Volume 2 to this ES).

L5.21 The flood extents in the post-development scenario remain largely the same as those in the baseline scenario. There are changes in flood levels upstream of the River Ouzel Crossing (Highway Link 107). Flood waters have a greatest increase in depth in the reach where the Broughton Brook converges with the River Ouzel. In this section an increase in modelled peak flood depths of 510mm is predicted for the 1 in 100 plus 35% climate change scenario, and an increase of 580mm is predicted for the 1 in 100 plus 65% climate change scenario. This is an

area designated as a linear park as it is located within the functional floodplain so an increase in flood risk here is considered to have a low magnitude effect.

L5.22 To ensure that future residents and users of the development are not at risk of fluvial flooding, each of the development parcels which are adjacent to the River Ouzel floodplain are to be raised 600mm above the 1 in 100 year plus 35% climate change flood level. These platform levels remain above the sensitivity design threshold of the 1 in 100 year plus 65% climate change flood level along with the 1 in 1,000 year flood level.

L5.23 The linear park is to be located within the function floodplain and as a result of the development the number of users of the functional floodplain will increase, thereby exposing more users to flood risk. However, during times of flood the waters are expected to raise relatively slowly, with the safety of the users of the linear park ensured through the provision of multiple safe access and egress routes out of the floodplain to the development parcels, as detailed in the FRA.

L5.24 Where 'hard' surfaces are proposed as part of the development, there will be in an increase in impermeable areas and therefore associated surface water runoff, compared with the existing, undeveloped situation. Without mitigation, this would increase peak surface water discharge to the onsite watercourses, as well as increasing volumetric runoff.

L5.25 To mitigate the risk of increased surface water flooding the SWS, which forms part of the inherent development design, has been designed to reduce the probability of surface water flooding at the Development Site and in the surroundings and ensure that there are no detrimental effects to surface water flooding in the receiving drainage systems.

L5.26 The SWS will restrict peak flows from the impermeable areas to the equivalent greenfield runoff rate (QBAR or 4/l/s/impermeable hectare, whichever is less).

L5.27 The sensitivity of the future residents and users of the Proposed Development to flood risk is considered to be high.

L5.28 Considering the embedded mitigation as detailed within the FRA and drainage strategy, the magnitude of change / effect prior to mitigation is considered to be Low.

Changes in the risk of fluvial and surface water flooding on the surrounding area

L5.29 As detailed in the section regarding changes in the risk of surface water and fluvial flooding at the Development Site, there are several components of the development which have the potential to impact the flood regime of the River Ouzel.

L5.30 However, the post-development model demonstrates that the A422 bridge, at the downstream extent of the Development Site is the key constraint to flow conveyance downstream and this is the same as in the baseline model. There are no substantial changes to the flood regime as a result of the Proposed Development.

L5.31 A comparison of the baseline and post-development modelled flood extents for the River Ouzel shows that there are no impacts on third party land, with the exception of the area downstream of the River Ouzel Crossing (Highway Link 107), where the levels increase between 0.01m to 0.1m, and the land to the west of the Anglian Water WWTW where the levels increase by between 0.01m and 0.1m.

L5.32 The area downstream of the River Ouzel Crossing (Highway Link 107) is part of the current floodplain and is owned by Milton Keynes Council (who in their role as the Local Planning Authority will determine the planning application). The Council has confirmedduring the pre-application discussions that their aspirations are for this area to become part of the linear park.

L5.33 The land adjacent to the Anglian Water WWTW is also situated on land owned by the Milton Keynes Development Partnership (MKDP) and is part of the current floodplain. The increase in flood extents here is **negligible** as is the increase in flood depths.

L5.34 As outlined in the approach to flood management report (appended to the FRA is Appendix L1, Volume 2 to this ES) the post-development hydraulic model demonstrates that there is no change in the peak flows that are conveyed downstream towards Newport Pagnell nor is there a change in the flood levels at Newport Pagnell.

L5.35 Considering the embedded mitigation as detailed within the FRA and drainage strategy (as detailed in Paragraphs L5.22 to L5.26), the magnitude of change / effect prior to mitigation is considered to be Low.

L5.36 The sensitivity of residents and users of the surrounding area to changes in flood risk is considered to be high.

Changes in groundwater flows during flood events as a result of the highway embankment that may impact the groundwater regime of the superficial aquifers

L5.37 The proposed Development lies on superficial head and alluvium deposits, consisting of clay, silt, sand are gravel which are classified as a Secondary A aquifer. Along the floodplain of the River Ouzel there is surface water – groundwater interaction within the superficial aquifers.

L5.38 The proposed crossing of the River Ouzel (Highway Link 107) will form an embankment across the floodplain, however no piling is planned. Providing that the proposed embankment does not significantly interact with, or impact upon the aquifer then there is no prospect for any impact upon the groundwater regime.

L5.39 The sensitivity of the identified habitats that have an element of groundwater reliance such as the grassland to the west of the River Ouzel, is assessed to be Low. The magnitude of effect prior to mitigation is considered to be no change.

Changes to the drainage regime – quantity and quality of surface water discharged to the water environment

L5.40 As detailed in the section regarding changes in the risk of surface water flooding at the Development Site, the SWS will restrict peak flows from the impermeable areas to the equivalent greenfield flow (QBAR or 4/l/s/impermeable hectare, whichever is less).

L5.41 This will provide a degree of betterment in the peak flows discharged from the Development Site into the upper tributaries (as requested by the Environment Agency). Thereby there is not expected to be an increase in the quantity of surface water discharged as a result of the development.

L5.42 Changes in the quality of surface water discharged have been assessed under the Water Framework Directive, see Appendix L3 (Volume 2 to this ES) for the Water Framework Directive Assessment. The Broughton Brook, the Ouzel Us of Caldecote Mill and the Ouzel Ds of Caldecote Mill are the waterbodies that have been assessed under the WFD.

L5.43 The WFD assessment states that it is not envisaged that the development would cause a deterioration in the status/potential of any of the three assessed waterbodies for biological water quality elements.

L5.44 For Phyisco-chemical water quality elements there is the potential for an increase in biochemical oxygen demand as a result of increased road run-off entering the receiving waterbodies. There is also the potential for an increase in ammonia and nitrates as a result of

increased road run-off. Embedded mitigation within the design of Sustainable Urban Drainage Systems (SuDS) and outfalls would ensure water quality standards are met.

L5.45 In addition to the WFD assessment, the Highways England Water Risk Assessment Tool (HEWRAT) has been used to assess how key pollutants from the road run-off may impact on the quality of the receiving waterbodies, assessing the proposed outfalls from the development.

L5.46 Based on the proposed highways design, there are three outfalls to the River Ouzel, four to the Moulsoe Stream, one to the Hermitage Stream and one to the Barn Stream. The outfalls to the Moulsoe Stream and those directly the River Ouzel are within the Ouzel Us of Caldecote Mill WFD catchment. The outfalls on the Hermitage Stream and Barn Stream are within the Broughton Brook WFD catchment.

L5.47 Routine Runoff and Spillage Risk Assessments have been undertaken for each of the nine outfalls, this is detailed in Appendix L4 (Volume 2 to this ES).

L5.48 Each of the outfalls draining to the Ouzel pass the routine runoff assessment as does the cumulative assessment of the three outfalls.

L5.49 For the outfalls draining to the Moulsoe Stream, the Hermitage Stream and the Barn Stream it was necessary to undertake groundwater quality routine runoff assessment, as these watercourses have Q95 values below 1 l/s.

L5.50 For each of the outfalls on the Moulsoe, Hermitage and Barn Streams, the overall risk from the groundwater assessment is on the threshold of Low to Medium.

L5.51 Guidance from the DMRB [Ref 35] states that "*Where the risk indicated in a groundwater quality and routine runoff simple assessment is medium or high, a detailed assessment shall be completed by a competent expert with the degree of detail being appropriate to the medium or high result".*

L5.52 A detailed assessment will be undertaken as required at the detailed design stage, subject to the design approach adopted in the drainage strategy, following liaison with the Highways Authority. As the mitigation that will be included in the system is subject to the design approach. This mitigation could include, lining the ponds (to prevent groundwater interaction or pre-treatment of the runoff prior to entering the treatment / attenuation ponds.

L5.53 For the spillage risk HEWRAT assessment, the entire highways network passes the assessment, with the Proposed Development's surface water discharge network meeting the minimum DMRB standard for sensitive watercourses.

L5.54 Based on the results of the HEWRAT assessment and the findings of the WFD assessment, the impact on surface water quality discharged to the water environment is assessed to be Low.

L5.55 The sensitivity of the Rive Ouzel and Broughton Brook to changes in surface water quality are assessed to be low.

L6.0 Mitigation and Monitoring

During Construction

Changes in the risk of surface water and fluvial flooding at the Development Site and their effects on potential receptors (i.e. construction workers)

L6.1 A temporary drainage solution will be implemented for each phase of the construction programme and will ensure the management of surface water runoff on site until the permanent surface water drainage solutions are incorporated.

L6.2 The temporary drainage solution will include local flood prevention measures, in line with best practice and policy to mitigate both flood risk and sediment loading and will ensure any increase in surface water run-off above pre-development rates are managed and attenuated on-site.

L6.3 The proposed temporary drainage solution for the construction phases will be developed by the contractor prior to enabling works and approved by MKC.

L6.4 The temporary construction area for the Highway Link 107 (the River Ouzel Crossing) will be developed by the contractor prior to enabling works and approved by the Environment Agency but is currently envisaged that the construction area will be surrounded by earth bunds or similar to prevent any flood waters reaching the construction site.

L6.5 A Construction Environmental Management Plan (CEMP) will ensure that there is no construction storage within the open floodplain and that the contractor has an emergency flood management plan for any works that are to be undertaken within the open floodplain (such as the river crossings and works to the linear park).

L6.6 During construction, the potential receptors of changes in flood risk at the Development Site are the construction workers.

L6.7 The sensitivity of construction workers is considered to be medium, and the magnitude of change/effect following the implementation of the temporary drainage solution and the CEMP, is considered to be low.

Changes in groundwater flows during flood events as a result of the highway embankment that may impact the groundwater regime of the superficial aquifers

L6.8 Providing that the proposed embankment does not significantly interact with, or impact upon the underlying aquifers then there is no prospect for any impact upon the groundwater regime. Therefore, the pre-mitigation magnitude of effect remains the same and no mitigation is proposed. The magnitude of effect is considered to be no change.

L6.9 The sensitivity of the identified habitats that have an element of groundwater reliance such as the grassland to the west of the River Ouzel, is assessed to be Low.

Changes in the risk of surface water flooding on the surrounding areas and their effects on potential receptors (i.e. residents and users)

L6.10 As with the changes in surface water flood risk at the Development Site, the off-site risk of surface water flooding will be managed though a temporary drainage solution during the construction phases.

L6.11 The temporary drainage solution will ensure any increase in surface water run-off above pre-development rates are managed and attenuated on-site, therefore there will be no increases in surface water runoff to off-site areas during the construction stage.

L6.12 The sensitivity of users and residents of the surrounding area to changes in the risk of surface water flooding is assessed to be High. The magnitude of effect considering the implementation of the temporary drainage solution is considered to be Low.

Changes to the quality (i.e. physical & chemical contamination) of surface water discharged to the water environment

L6.13 A CEMP will be adopted during the construction phases to prevent physical and chemical pollutants entering the drainage system.

L6.14 It is anticipated that the CEMP would detail the controls and measures to be adopted during construction (such as managing any accidental spillages). The CEMP would be agreed with MKC and demonstrate compliance with the Guidance for Pollution Prevention (GPPS) and Pollution Prevention Guidelines (PPGs) Refs 37 to 42.

L6.15 In addition, the construction works would be managed in accordance with CIRIA guidance 'C532 - Control of Pollution from Construction Sites' Ref. L32 to help ensure a well-managed operation which minimises potential environmental risks.

L6.16 The sensitivity of the drainage network is assessed to be Low. The magnitude of change following mitigation is considered to be **negligible**.

During Operation

Changes in risk of fluvial and surface water flooding at the Development Site and their effects on potential receptors (i.e. residents and users)

L6.17 As a result of the incorporation of the proposed design solutions, the FRA and SWS (embedded mitigation), the magnitude of change is considered to be Low. To ensure the safety of the users of the linear park (located in the functional floodplain) appropriate signage is recommended to ensure users are aware of the risks and know where the safe access and egress routes out of the linear park are. The magnitude of effect following the signage mitigation is considered to be **negligible**.

L6.18 The sensitivity of the future residents and users of the Development Site to changes in flood risk is assessed to be High.

Changes in risk of fluvial and surface water flooding on the surrounding area and their effects on potential receptors (i.e. residents and users)

L6.19 As a result of the incorporation of the proposed design solutions, the FRA and the SWS (embedded mitigation), the magnitude of change is considered to be **negligible** and no additional mitigation measures are required.

L6.20 The sensitivity of the residents and users of the surrounding area to changes in flood risk is assessed to be High.

Changes in groundwater flows during flood events as a result of the highway embankment that may impact the groundwater regime of the superficial aquifers

L6.21 Providing that the proposed embankment does not significantly interact with, or impact upon the aquifer then there is no prospect for any impact upon the groundwater regime. Therefore, the pre-mitigation magnitude of effect remains the same and no mitigation is proposed. The magnitude of effect is considered to be no change.

L6.22 The sensitivity of the identified habitats that have an element of groundwater reliance such as the grassland to the west of the River Ouzel, is assessed to be Low.

Changes to the drainage regime – quantity and quality of surface water discharged to the water environment.

L6.23 Considering the embedded mitigation outlined in the FRA and SWS there will be no increase in the quantity of surface water discharged from the Development Site as a result of the Proposed Development, therefore no additional mitigation measures are required.

L6.24 Regarding water quality, the HEWRAT assessment undertaken for the Development Site shows that there is predicted to be a sufficient reduction in key pollutants from highways runoff entering the receiving waterbodies so as to not adversely impact upon water quality.

L6.25 The WFD assessment concludes that it is not envisaged that the development would cause deterioration in the status/potential of the River Ouzel or Broughton Brook for the physico-chemical quality elements due to the proposed embedded mitigation in the outfalls. Therefore, no additional mitigation measures are proposed for water quality.

L6.26 The sensitivity of River Ouzel and Broughton Brook to changes in quantity and quality of surface water is assessed to be Low.

L7.0 Residual Effects

L7.1 The significance of the residual effects of the below impacts are assessed after mitigation has been considered.

During Construction

Changes in the risk of surface water and fluvial flooding at the Development Site and their effects on potential receptors (i.e. construction workers)

L7.2 The sensitivity of construction workers is considered to be medium, and the magnitude of change/effect following the implementation of the temporary drainage solution and the CEMP, is considered to be low. Therefore, there is likely to be a direct, temporary, medium-term **negligible adverse** (not significant) effect on the construction workers following the implementation of the mitigation measures.

Changes in groundwater flows during flood events as a result of the highway embankment that may impact the groundwater regime of the superficial aquifers

L7.3 The sensitivity of the floodplain habitats that have an element of groundwater reliance is assessed to be Low. It is not expected that the proposed highway embankment will impact upon the groundwater regime. Therefore, the magnitude of effect is no change and the significance of effect in neutral.

Changes in the risk of surface water flooding on the surrounding areas and their effects on potential receptors (i.e. residents and users)

L7.4 The sensitivity of the residents and users of the surrounding areas is considered to be high, and the magnitude of change/effect following the implementation of the temporary drainage solution and the CEMP, is considered to be low. Therefore, there is likely to be a direct, temporary, medium-term **minor adverse** (not significant) effect on the residents and users of the surrounding site following the implementation of mitigation measures.

Changes to the quality (i.e. physical & chemical contamination) of surface water discharged to the water environment

L7.5 The sensitivity of the water environment to changes in surface water quality is assessed to be Low. Following the implementation of the temporary drainage solution and CEMP, the magnitude of effect is considered to be Low. Therefore, there is likely to be a direct, temporary, medium-term **minor adverse** (not significant) effect on the drainage network.

During Operation

Changes in risk of fluvial and surface water flooding at the Development Site and their effects on potential receptors (i.e. residents and users)

L7.6 The sensitivity of the residents and users of the Development Site is considered to be high, and considering the embedded mitigation in the FRA and SWS, in addition to the mitigation of signage in the linear park, the magnitude of effect, is considered to be **negligible**. Therefore, there is likely to be a direct, permanent, **negligible adverse** (not significant) effect on the residents and users of the Development Site.

Changes in risk of fluvial and surface water flooding on the surrounding area and their effects on potential receptors (i.e. residents and users)

L7.7 The sensitivity of the residents and users of the surrounding area is considered to be high, and considering the embedded mitigation in the FRA and drainage strategy the magnitude of change, is considered to be **negligible**. Given there is no additional mitigation in relation to changes in risk of flooding on the surrounding areas their effects on potential receptors, the pre-mitigation finding remains the same. Therefore, there is likely to be a direct, permanent, **negligible adverse** (not significant) effect on the residents and users of the surrounding areas.

Changes in groundwater flows during flood events as a result of the highway embankment that may impact the groundwater regime of the superficial aquifers

L7.8 The sensitivity of the floodplain habitats that have an element of groundwater reliance is assessed to be Low. It is not expected that the proposed highway embankment will impact upon the groundwater regime. Therefore, the magnitude of effect is no change and the significance of effect is **neutral**.

Changes to the drainage regime – quantity and quality of surface water discharged to the water environment.

L7.9 The sensitivity of the water environment to changes in quantity and quality of surface water is assessed to be Low. Considering the embedded mitigation outlined in the FRA and SWS there will be no increase in the quantity of surface water discharged from the Development Site as a result of the Proposed Development, therefore no additional mitigation measures are required. Considering the embedded mitigation discussed in the WFD assessment, the development will not cause a deterioration in the water quality status of the drainage network. Therefore, there is likely to be a direct, permanent, **negligible adverse** (not significant) effect on the water environment.

L8.0 Summary & Conclusions

L8.1 This assessment has been undertaken to determine the potential effects of the Proposed Development on water resources, flood risk and drainage.

L8.2 The Environment Agency's Flood Map for Planning shows that the majority of the Development Site is located in Flood Zone 1, with less than 1 in 1000 (0.1%) chance of flooding from rivers in any given year.

L8.3 Based on the baseline hydraulic modelling of the River Ouzel and Broughton Brook, approximately 10% of the Development Site is within the 1 in 20 year flood extents and is considered to be in the functional floodplain. Approximately 12% of the Development Site is within the modelled 1 in 100 year fluvial flood extents (equivalent to Flood Zone 3), with approximately 13% of the Development Site shown to be within the 1 in 1000 year flood extents (equivalent to Flood Zone 2).

L8.4 With the exception of proposed highways crossings all built development will be outside of the fluvial floodplain. It is proposed that the floodplain of the River Ouzel is turned into a linear park.

L8.5 The potential effects that were identified during the construction phases were:

1 Changes in the risk of surface water and fluvial flooding at the Development Site and their effects on potential receptors (i.e. construction workers);

2 Changes in groundwater flows during flood events as a result of the highway embankment that may impact the groundwater regime of the superficial aquifers;

3 Changes in the risk of surface water flooding on the surrounding areas and their effects on potential receptors (i.e. residents and users); and

4 Change to the quality (i.e. physical & chemical contamination) of surface water discharged to the water environment.

L8.6 The potential effects that were identified during operation were:

1 Changes in risk of fluvial and surface water flooding at the Development Site and their effects on potential receptors (i.e. residents and users);

2 Changes in risk of fluvial and surface water flooding on the surrounding area and their effects on potential receptors (i.e. residents and users);

3 Changes in groundwater flows during flood events as a result of the highway embankment that may impact the groundwater regime of the superficial aquifers;

4 Changes to the drainage regime – quantity and quality of surface water discharged to the water environment.

L8.7 A temporary drainage solution will be put in place at the construction phase, as a mitigation measure to manage the risk of flooding and pollution events during construction.

L8.8 A CEMP will also be in place during the construction phase as an additional mitigation measure to manage both chemical and physical contaminants entering surface water and groundwater bodies.

L8.9 At the operational phase the SWS (Appendix L2, Volume 2 to this ES) will be put in place as part of the inherent design and ensure that there are no detrimental effects to surface water flooding or degradation to receiving waterbodies. The general principles applied to the drainage strategy

for the Proposed Development will be to control surface water run-off through the use of suitable Sustainable Drainage Systems (SuDS) in accordance with relevant policy and guidance.

L8.10 As outlined in the FRA (Appendix L1, Volume 2 to this ES), all development will be raised above the 1 in 100 year plus 35% climate change flood level to ensure that the development does not increase the risk of fluvial flooding on site or downstream.

L8.11 In addition to the embedded mitigation in the FRA which ensures the safety of residents and users of the development parcels and the safety of residents and users of downstream communities, appropriate warning signage will be installed along the linear park as an additional mitigation measure to ensure the safety of the users of the linear park.

L8.12 Following the implementation of appropriate mitigation measures the Proposed Development will not result in any adverse significant residual effects on the water resources, flood risk or drainage of the Proposed development.

L8.13 A summary of the findings of this assessment is shown in Table 8.1.

Table L8.1 Summary of impacts on the Water Environment

Description of Effects	Receptor(s)	Summary of mitigation Measures	Significance and Nature of Residual Effects
Construction Phase			
Changes in the risk of surface water and fluvial flooding at the site and their effects on potential receptors	Construction workers	Temporary drainage solutions and CEMP implemented during the construction phase	Negligible - / T / D / MT
Changes in groundwater flows during flood events as a result of the highway embankment that may impact the groundwater regime of the superficial aquifers	Groundwater dependent habitats	No mitigation measures required as proposed highway embankment is not expected to interact with the underlying aquifers or impact the groundwater regime.	Neutral
Changes in the risk of surface water flooding on the surrounding areas and their effects on potential receptors	Residents and users	Temporary drainage solutions and CEMP implemented during the construction phase	Negligible - / T / D / MT
Change to the quality (i.e. physical & chemical contamination) of surface water discharged to the water environment	Surface waterbodies	Temporary drainage solutions and CEMP implemented during the construction phase	Minor - / T / D / MT
Operational Phase			
Changes in risk of fluvial and surface water flooding at the Site and their effects on potential receptors	Future site occupants / users (staff, residents & public)	FRA and SWS form part of the inherent design of the development. Warning signage to be installed in linear park as this is located in the functional floodplain.	Negligible - / P / D
Changes in risk of fluvial and surface water flooding on the surrounding area and their effects on potential receptors	Residents / users of the surrounding area	FRA and SWS form part of the inherent design of the development, no additional mitigation required.	Negligible - / P / D

Description of Effects	Receptor(s)	Summary of mitigation Measures	Significance and Nature of Residual Effects
Changes in groundwater flows during flood events as a result of the highway embankment that may impact the groundwater regime of the superficial aquifers	Groundwater dependent habitats	No mitigation measures required as proposed highway embankment is not expected to interact with the underlying aquifers or impact the groundwater regime.	Neutral
Changes to the drainage regime – quantity and quality of surface water discharged to the water environment	River Ouzel and Broughton Brook	No mitigation measures required as the WFD assessment demonstrates that the development will not impact the water quality status of these watercourses; and the FRA and SWS demonstrate that there will be no increase in the amount of surface water discharged.	Negligible - / P / D

Key: + / - = 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

L9.0 Abbreviations & Definitions

1 CEMP - Construction Environmental Management Plan
2 EA - Environment Agency
3 EIA – Environmental Impact Assessment
4 ES – Environmental Statement
5 FRA - Flood Risk Assessment
6 HEWRAT - Highways England Water Risk Assessment Tool
7 HMR - Hydraulic Modelling Report
8 IDB - Internal Drainage Board
9 LLFA - Lead Local Flood Authority
10 MKC - Milton Keynes Council
11 RBMP - River Basin Management Plan
12 SWS - Surface Water Strategy
13 WFD - Water Framework Directive

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