# Appendix L3
## WFD Assessment

St James Group Limited

# MILTON KEYNES EAST

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MARCH 2021

PUBLIC

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WSP

Three White Rose Office Park
Millshaw Park Lane
Leeds
LS11 0DL

Phone: +44 113 395 6200

Fax: +44 113 395 6201

WSP.com

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| Signature | | | |
| Checked by | Helena Parsons | Helena Parsons | Helena Parsons |
| Signature | | | |
| Authorised by | Andy Smith | Andy Smith | Andy Smith |
| Signature | | | [redacted] |
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# 1 INTRODUCTION

## 1.1 BACKGROUND

1.1.1. WSP UK Ltd (WSP) has been appointed by St James Group Ltd (St James) to prepare a Water Framework Directive Assessment (WFDa) to support the planning application for a large mixed use development located on the land to the east of the M1 Motorway at Milton Keynes, (Approximate Post Code: MK15 9LZ).

1.1.2. This (WFDa) has been prepared in order to assess the risks to the water environment posed by the Milton Keynes East development, hereafter referred to as the Scheme. The Scheme interacts with a number of watercourses: thus, each activity associated with the Scheme, such as watercourse crossings, culverts and outfalls, will be assessed against the biological, physico-chemical and hydromorphological quality elements that comprise the WFD.

## 1.2 STUDY AREA

1.2.1. The Scheme is located between the M1 which largely forms the southern boundary of the site and the A422 which forms the northern boundary, with the River Ouzel flowing through the Scheme extents. The River Ouzel flows generally to the north-west, through the town of Newport Pagnell before joining the River Great Ouse. The grid reference for the site is 488630, 241770 and the location of the site is shown in Figure 1-1.

1.2.2. The study area for this WFD assessment includes the site and a 1km buffer area around the Scheme extents. Other WFD receptors located up to 5km downstream of the Scheme which are hydrologically connected and have potential to be impacted are also included.

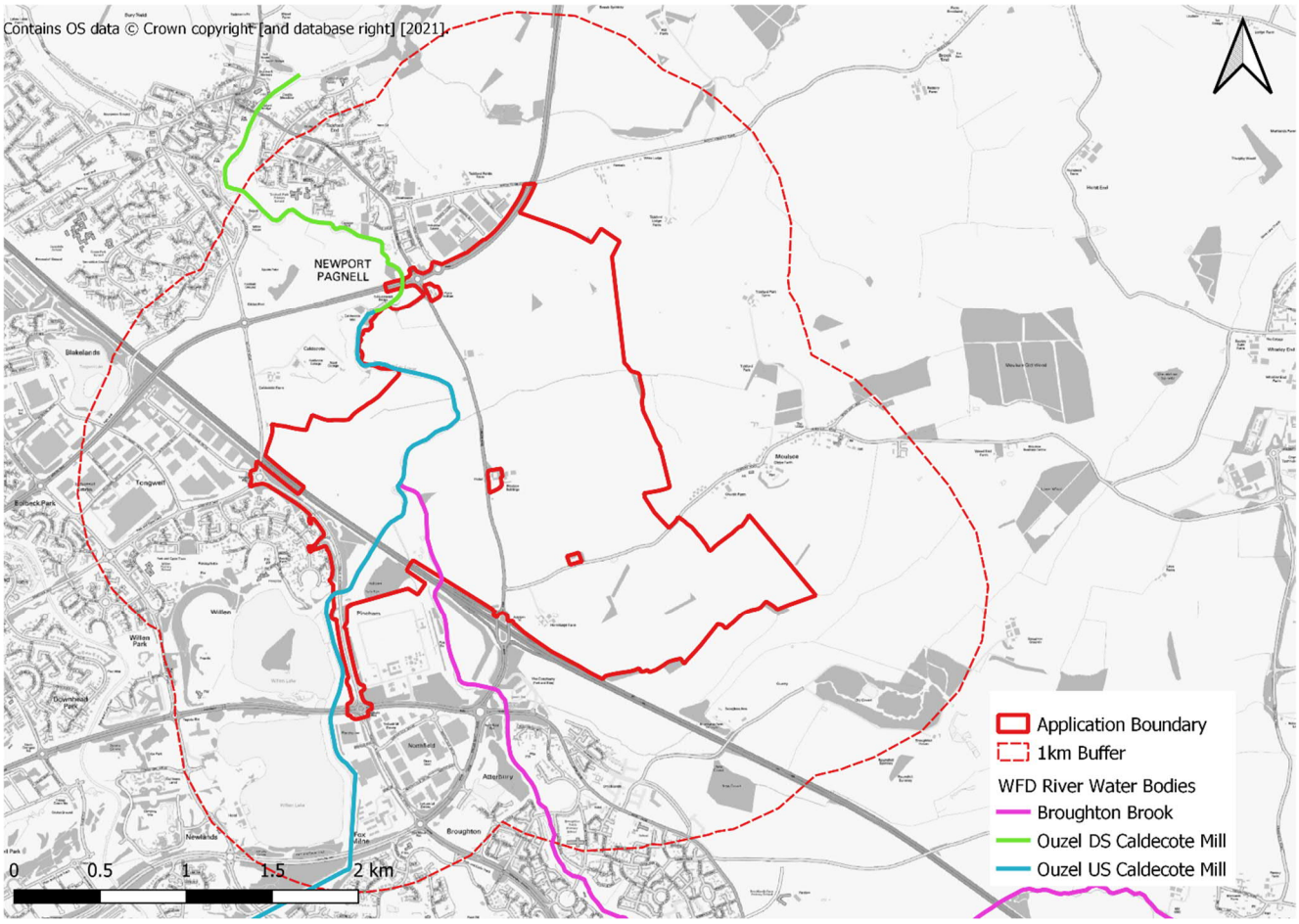



**Figure 1-1 - Site boundary, study area and WFD water bodies**

## 1.3 THE SCHEME

1.3.1. 'Milton Keynes East' (MKE) has been identified as an allocation for a strategic urban extension within Plan:MK and Milton Keynes Council's (MKC) aspirations for the allocation is set out within Policy SD12 of Plan:MK.

1.3.2. The broad configuration of the proposed layout / land uses for the Scheme is shown in Figure 1-2 against which this assessment has been prepared, subsequently the land use parameter plan has been updated and is appended to Chapter C of the ES at Appendix C2 and the illustrative plot plan which is included as Figure C3.2 of Chapter C. This updated parameter plan does not change the findings of the assessment. The proposed Scheme is a large-scale mixed-use urban extension (creating a new community) including:

- Approximately 4,000 up to a maximum of 4,600 new homes;
- Up to 403,650 sq.m of employment floorspace;
- A community hub containing a range of commercial and community uses;
- Associated services, amenities and open space; and
- New road and redway extensions, including a new bridge over the M1 motorway and works to the Tongwell Street corridor."


**Figure 1-2 – Illustrative Parameter Plan**

## 1.4 HYBRID PLANNING APPLICATION

1.4.1. The planning application for the Scheme is a hybrid application where the majority of the site will be submitted for outline planning permission, whilst some elements will be submitted for full planning permission. Those elements submitted for full planning permission are considered within this WFD assessment, which are described in Section 1.5, and include the following:

- New highway Link 107 (including the bridge crossing of the River Ouzel);
- Widening of V11 with new Tongwell Street Road Bridge;
- Replacement of existing culvert on Moulsoe Brook;
- New road bridge crossing of Moulsoe Brook;
- Highway drainage system, including outfalls to receiving watercourses and attenuation basins; and
- Bank protection along the River Ouzel, beneath and downstream of the new Highway Link 107, to protect the remains of a Viking settlement on the right bank (shown in Figure 1-3 and Figure MKE-WSP-ZZ-ZZ-C-DR-0014-P02 in Appendix A) and beneath / around the widening of Tongwell Street Bridge shown on Figure MKE-WSP-ZZ-ZZ-C-DR-0012-P02 in Appendix A.


**Figure 1-3 – Potential extent of bank protection at, and downstream of, Highway Link 107.**

## 1.5 ELEMENTS OF THE SCHEME SUBMITTED FOR FULL PLANNING PERMISSION

### WIDENING OF V11 (TONGWELL STREET ROAD BRIDGE)

1.5.1. As part of the dualling of V11 (Tongwell Street), a new bridge would be constructed across the River Ouzel to provide two additional road lanes. This bridge would be parallel to and largely mirroring the existing bridge and embankments with a span of 84m. There would be two sets of piers, each consisting of four 70mm diameter columns, both located on the right bank of the River Ouzel. Due to the river geometry and structural design requirements it is not possible to align the new and existing piers. Design drawings of the Scheme are presented in Appendix A.

### HIGHWAY LINK 107

1.5.2. The new link road (herein referred to as 'Highway Link 107') crosses the western floodplain of the River Ouzel on an embankment before crossing the River Ouzel on a 30m clear span bridge, across the 20m channel with a shared footpath / cycle way on each bank. The soffit level of the bridge is approximately 3.2m above the 1 in 100-year flood level with 35% climate change allowance. The bridge deck has a width of 30.1m.

1.5.3. Highway Link 107 is raised across the floodplain on an embankment. The level difference between the existing ground levels and the proposed levels of the embankment varies across the floodplain, but at its greatest is 6.89m. The embankment has two flood relief culverts through it which will also act as pedestrian underpasses during normal flow conditions. Design drawings of the Scheme are presented in Appendix A.

### MOULSOE BROOK CULVERT REPLACEMENT

1.5.4. The existing 19m culvert that conveys flow under the A509 London Road would be replaced with a new 21m culvert pipe culvert or an equivalent size (900mm diameter).

### MOULSOE BROOK HIGHWAY CROSSING

1.5.5. The Moulsoe Brook crossing would be a single span crossing that also serves as an equestrian subway.

### SURFACE WATER DRAINAGE

1.5.6. It is proposed that the surface water drainage from the development parcels and highway network (including Highway Link 107) would be through a SuDs based drainage strategy. It is currently proposed that the surface water runoff is collected via swales and drained to attenuation basins before discharging via swales / channels to the River Ouzel. Some aspects will outfall into the Broughton Brook or the Moulsoe Brook (both of which are designated Internal Drainage Board watercourses and are tributaries of the River Ouzel).

1.5.7. Runoff rates and volumes from the developed land would be restricted to the greenfield rate and volume up to the 1 in 100yr with a 40% climate change allowance with a maximum discharge rate of 4l/s per impermeable hectare. Treatment of drainage would be through the swales and attenuation

basins. Further information on the proposed surface water drainage system is detailed within the accompanying Surface Water Drainage Strategy.

## 1.6 ELEMENTS OF THE SCHEME SUBMITTED FOR OUTLINE PLANNING

1.6.1. The following elements will be submitted for outline planning permission. This WFD assessment does not assess the compliance of these elements against the WFD as the design is not yet sufficiently detailed. These could be assessed through an update to this WFD assessment as part of the reserved matters applications, if required.

- Residential and mixed-used buildings;
- Minor roads and associated drainage networks, outfalls and watercourse crossings;
- Linear park through River Ouzel floodplain corridor, including boardwalk crossings over the River Ouzel;
- Raising of development platforms out of the floodplain; and,
- New playground on raised platform in the floodplain.

## 1.7 CONSULTATION

1.7.1. A teleconference was held on 19 January 2021 with an Environment Agency (EA) geomorphologist to discuss and agree the scope of the WFD assessment required to support this planning application. The minutes of this teleconference are presented in Appendix B. The screening and scoping process discussed and agreed in this meeting is presented in Section 2 and 3.

1.7.2. Through consultation, the EA has requested that all potentially impacted WFD water bodies are screened into this assessment, however the assessment of compliance for these elements is to be conditioned as part of the outline planning permission.

# 2 WFD SCREENING

## 2.1 WFD WATER BODIES

2.1.1. There are six WFD water bodies within 1km of the Scheme. The screening of these WFD water bodies is presented in Table 2-1. This screening outcome has been reviewed and agreed by the EA through a consultation meeting held on 19 January 2021 (Appendix B).

**Table 2-1 - Screening of WFD water bodies**

| WFD water body (ID) | Screen in / out? | Justification |
|---|---|---|
| **River Ouzel US Caldecote Mill** (GB105033037971) | **In** | The Scheme is located within this WFD water body. There are proposed works which directly affect this water body. |
| **River Ouzel DS Caldecote Mill** (GB105033037972) | **In** | The watercourse of this designation immediately downstream of the Scheme and could be impacted by changes to the River Ouzel US Caldecote Mill water body associated with the Scheme. |
| **Broughton Brook** (GB105033037930) | **In** | The Scheme is within the Broughton Brook waterbody and there are outfalls to this watercourse proposed from the residential and employment development areas. |
| **River Great Ouse (Wolverton to Newport Pagnell)** (GB105033038000) | **Out** | This water body is located upstream of the River Ouzel confluence and therefore it is not expected to be impacted by the Scheme. |
| **River Great Ouse (Newport Pagnell to Roxton)** (GB105033047923) | **Out** | This water body is approximately 3.5km downstream of the Scheme and is unlikely to be impacted by changes to the River Ouzel US Caldecote Mill water body associated with the Scheme. |
| **Upper Bedford Ouse Principal Oolite 2 Groundwater body** (GB40501G445600) | **Out** | The Scheme is not located above this groundwater body. This groundwater body is located beneath the downstream River Great Ouse (Newport Pagnell to Roxton) but it is not expected to be indirectly impacted by the Scheme. |

## 2.2 SCHEME ACTIVITIES

**Table 2-2 - Screening of Scheme activities**

| Activity | Screen in / out? | Potentially affected WFD water bodies | Justification |
|---|---|---|---|
| **Tongwell Street Road Bridge**<br>A new bridge crossing the River Ouzel. This would be clear span over the watercourse however there would be two sets of piers located within the floodplain (right bank). | **In** | River Ouzel US Caldecote Mill (GB105033037971)<br>River Ouzel DS Caldecote Mill (GB105033037972) | Potential for riparian impacts due to shading. |
| **Highway Link 107**<br>A new road crossing the River Ouzel (on a clear span bridge) and its floodplain on an embankment. Footpaths would be located on both banks of the River Ouzel and two flood relief culverts would be included in the embankment crossing. | **In** | River Ouzel US Caldecote Mill (GB105033037971)<br>River Ouzel DS Caldecote Mill (GB105033037972)<br>Broughton Brook (GB105033037930) | Potential for riparian impacts due to shading. |
| **Moulsoe Brook culvert replacement**<br>Replacement of a 21-metre pipe culvert under the A509 London Road | **In** | River Ouzel US Caldecote Mill (GB105033037971)<br>River Ouzel DS Caldecote Mill (GB105033037972) | Replacement of an existing culvert with a longer culvert would potentially impact riparian habitat other hydromorphological quality elements of the watercourse. |
| **Moulsoe Brook new highway crossing**<br>A new single span crossing that also serves as an equestrian subway | **In** | River Ouzel US Caldecote Mill (GB105033037971)<br>River Ouzel DS Caldecote Mill (GB105033037972) | Potential for riparian and hydromorphological impacts due to shading and a new structure over the watercourse. |

| Activity | Screen in / out? | Potentially affected WFD water bodies | Justification |
|---|---|---|---|
| **Surface water drainage**<br>Three outfalls installed on River Ouzel for highway drainage. Highway drainage restricted to greenfield rates and treated via swales and attenuation ponds.<br>Additional surface water drainage from public realm and residential areas. | **In** | River Ouzel US Caldecote Mill (GB105033037971)<br>River Ouzel DS Caldecote Mill (GB105033037972)<br>Broughton Brook (GB105033037930) | New structures in the watercourse introducing highway and urban drainage with potential to impact hydromorphological and physico-chemical quality elements. |
| **Attenuation basins**<br>Eight attenuation basins to provide storage of highway runoff in order to provide treatment and restriction of discharge rates to the River Ouzel. | **Out** | River Ouzel US Caldecote Mill (GB105033037971)<br>River Ouzel DS Caldecote Mill (GB105033037972) | Proposed basins are located away from the watercourse and out of the floodplain. |

# 3 WFD SCOPING

3.1.1. For each of the three surface water bodies scoped into the assessment, Table 3-1 and Table 3-2 summarise which WFD quality elements are scoped into the assessment for both construction and operation phase.

**Table 3-1 – Scoping of WFD quality elements for the River Ouzel US Caldecote Mill water body (GB105033037971) and River Ouzel DS Caldecote Mill (GB105033037972).**

| WFD quality element | Scoping outcome | | | | |
|---|---|---|---|---|---|
| | Tongwell Street Road Bridge | Highway Link 107 | Moulsoe Brook Culvert replacement | Moulsoe Brook highway crossing | Surface water drainage |
| **Hydromorphology** | | | | | |
| Quantity and dynamics of flow | Out – Clear span structure not expected to affect this quality element. | In | In | Out – Clear span structure not expected to affect this quality element. | In |
| Connection to ground waters | Out – Measures employed in CEMP would negate potential risks to groundwater during construction phase. Not expected to affect operation phase. | | | | |
| River continuity | Out – Clear span structure not expected to affect hydrological or lateral connectivity with the floodplain. | In | In | Out – Clear span structure not expected to affect hydrological or lateral connectivity with the floodplain. | Out – Not expected to affect this quality element. Outfall structures would not impede hydrological or lateral connectivity. |
| River depth and width variation | In | In | In | In | In |
| Structure and substrate of the river bed | In | In | In | In | In |
| Structure of the riparian zone | In | In | In | In | Out – No substantial works in riparian zone. Outfall structures would be |

| WFD quality element | Scoping outcome | | | | |
|---|---|---|---|---|---|
| | Tongwell Street Road Bridge | Highway Link 107 | Moulsoe Brook Culvert replacement | Moulsoe Brook highway crossing | Surface water drainage |
| | | | | | small and set back from river banks. |
| **Physico-chemical** | | | | | |
| Thermal conditions | Out – Structure not expected to affect water quality. | Out – Structure not expected to affect water quality. | Out – Structure not expected to affect water quality. | Out – Structure not expected to affect water quality. | Out – Drainage not expected to affect temperature. |
| Oxygenation conditions | | | | | In |
| Salinity | | | | | In |
| Nutrient conditions | | | | | In |
| Specific pollutants | | | | | In |
| **Biological** | | | | | |
| Fish | In | In | In | In | In |
| Benthic invertebrates | In | In | In | In | In |
| Aquatic flora (macrophytes) | Out – Not monitored under WFD cycle 2 | | | | |
| Phytoplankton (diatoms) | Out – Not monitored under WFD cycle 2 | | | | |

**Table 3-2 - Scoping of WFD quality elements for the Broughton Brook water body (GB105033037930)**

| WFD quality element | Scoping outcome | |
|---|---|---|
| | Highway Link 107 | Surface water drainage |
| **Hydromorphology** | | |
| Quantity and dynamics of flow | In | In |
| Connection to ground waters | Out – Measures employed in CEMP would negate potential risks to groundwater during construction phase. Not expected to affect operation phase. | |
| River continuity | In | Out – Not expected to affect this quality element. Outfall structures would not impede hydrological or lateral connectivity. |
| River depth and width variation | In | In |
| Structure and substrate of the river bed | In | In |
| Structure of the riparian zone | In | Out – No substantial works in riparian zone. Outfall structures would be small and set back from river banks. |
| **Physico-chemical** | | |
| Thermal conditions | Out – Structure not expected to impact water quality elements. | Out – Drainage not expected to affect temperature. |
| Oxygenation conditions | | In |
| Salinity | | In |
| Nutrient conditions | | In |

| WFD quality element | Scoping outcome | |
|---|---|---|
| | Highway Link 107 | Surface water drainage |
| Specific pollutants | | In |
| **Biological** | | |
| Fish | Out – Not monitored under WFD cycle 2 | |
| Benthic invertebrates | In | In |
| Aquatic flora (macrophytes) | In | In |
| Phytoplankton (diatoms) | Out – Not monitored under WFD cycle 2 | |

## 3.2 INVASIVE NON-NATIVE SPECIES (INNS)

3.2.1. Himalayan Balsam (*Impatiens glandulifera*), Common Rhododendron *Rhododendron ponticum* and hybrid species Rhododendron *ponticum x maximum*, are all invasive non-native species included on Schedule 9 of the 1981 Wildlife and Countryside Act (as amended)[1], and it is an offence to release, plant or cause to grow in the wild any plant included on this schedule of the Act. Management works within the site should include the control of Himalayan Balsam to prevent its spread within or outside of the site. Unless further survey confirms that only non-invasive forms of Rhododendron are present at the site, it is recommended that management is extended to also include control of Rhododendron. A management plan for invasive non-native species would be adopted prior to the construction phase.

## 3.3 LIMITATIONS AND ASSUMPTIONS

3.3.1. Mitigation options to neutralise the impacts of the Scheme had to be tied in and compatible with other landscape and ecology mitigation plans proposed for the wider area and other developments proposed in the vicinity of the Scheme.

3.3.2. Covid-19 restrictions meant it was not possible to undertake any site visits, resulting in the exclusion of a range of surveys for this assessment, including baseline aquatic ecology geomorphology walkover surveys. The exclusion of aquatic ecology surveying (aquatic macro-invertebrates, aquatic macrophytes and fish) and water quality sampling was agreed with the Environment Agency. Instead, any existing fish, invertebrate, macrophyte and water quality data held by the Environment Agency has been used to inform this assessment and is broadly representative of the conditions in the River Ouzel and Broughton Brook. All other supporting information has been gathered from online resources.

[1] https://www.legislation.gov.uk/ukpga/1981/69/schedule/9

# 4 BASELINE

## 4.1 STUDY AREA

### CATCHMENT CHARACTERISTICS

4.1.1. The River Ouzel rises in the Chiltern Hills southeast of the Scheme 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 Scheme. Downstream of the Scheme the Ouzel flows north towards its confluence with the River Great Ouse in Newport Pagnell. The River Ouzel has a catchment area of approximately 366km$^2$.

4.1.2. The Broughton Brook is a tributary of the River Ouzel that rises southeast of the Scheme on the outskirts of Woburn. The Broughton Brook flows north through Husborne Crawley towards Junction 13 of the M1 before flowing west along the M1 where it joins the River Ouzel just north of Junction 14, within the boundary of the Scheme.

4.1.3. The topography of the River Ouzel catchment ranges between 247.3mAOD and 56.5mAOD. The predominant land use in the catchment is arable farming or horticulture (50% coverage), 30% of the land cover is grassland and 13.5% of the catchment is urbanised. Approximately 6% of the catchment is woodland and the remainder is classified as heathland.[2]

### CATCHMENT GEOLOGY AND SOILS

4.1.4. The bedrock geology in the catchment is mostly mudstone, siltstone and sandstone formations, with some limestone in the upper catchment. This is mostly classed as unproductive strata, however the Lower Greensand Group (Sandstone), located near Toddington is identified as a Principal Aquifer[3]. The superficial deposits near the watercourse are mostly sand and gravel river terrace deposits or clay, silt and sand alluvium. Elsewhere in the catchment the superficial deposits are mostly diamicton till[4].

4.1.5. Most soil across the catchment is loamy and clayey soils with impeded drainage. North of Leighton Buzzard and to the east of the catchment, the soil is freely draining and sandy soil.

### CATCHMENT HYDROLOGY

4.1.6. The average annual rainfall for the catchment is 637mm. The watercourse is gauged at Willen (upstream of the Scheme) where it is recorded that the mean flow in the River Ouzel is 2m$^3$/s and a low flow ($Q_{95}$) of 0.46m$^3$/s. The Broughton Brook is gauged just upstream of

[2] National River Flow Archive, available at: https://nrfa.ceh.ac.uk/data/station/spatial/33015 [last accessed December 2020]
[3] Defra Magic mapping, available at: https://magic.defra.gov.uk/magicmap.aspx [last accessed December 2020]
[4] Geology of Britain View, available at: https://mapapps.bgs.ac.uk/geologyofbritain/home.html [last accessed December 2020]

the M1 crossing. The mean flow in the Broughton Brook at this location is 0.323$m^3$/s and the low flow ($Q_{95}$) is 0.038$m^3$/s.

## HISTORIC CHANNEL CHANGE

4.1.7. A review of historical mapping[5] reveals that, at the location of the Scheme, the River Ouzel has not changed its planform since 1888 at the earliest. However, this is not necessarily indicative of a naturally inactive river system; rather, it is likely that the river at this location has probably been constrained through land management practices that were first implemented before formal mapping surveys. The historical river planform elsewhere suggests the River Ouzel was once an active system, with occasional bifurcated sections and tortuous meanders associated with a dynamic river system.

4.1.8. More recently, the watercourse has been constrained by the construction of the Tongwell Street Bridge, the M1 and A422 bridge crossings. Prior to 1888 the construction of Caldecote Mill and its weir introduced physical modifications to the natural channel. The River Ouzel has been heavily modified upstream of the Scheme between Tongwell Street and Brickhill Street due to the recent urbanisation of Milton Keynes and the construction of Willen Lake.

4.1.9. Broughton Brook has similarly undergone significant modification; however, its original highly sinuous planform is revealed in the earliest mapping records. The channel has been extensively straightened throughout most of its length.

## BIODIVERSITY

### Invasive Non-Native Species

4.1.10. During the Phase 1 habitat survey Himalayan Balsam was recorded along the River Ouzel corridor within the site and Rhododendron was recorded growing in the north of the site. American Signal Crayfish were not encountered during the invertebrate survey.

[5] National Library of Scotland, available at: https://maps.nls.uk/ [last accessed December 2020]

## 4.2 WFD WATER BODIES

### BACKGROUND

4.2.1. The RBMP provides a catchment-based approach to managing water bodies in accordance with the WFD. The Scheme is located within the Anglian RBD that is subsequently sub-divided into smaller management catchments. The Scheme is located entirely within the Ouse Upper and Bedford management catchment which is subsequently sub-divided into smaller operational catchments that is formed of individual water bodies or sections of water bodies for the purpose of monitoring their compliance with the WFD objectives. The catchments and water bodies relevant to the Scheme are summarised in Figure 4-1.

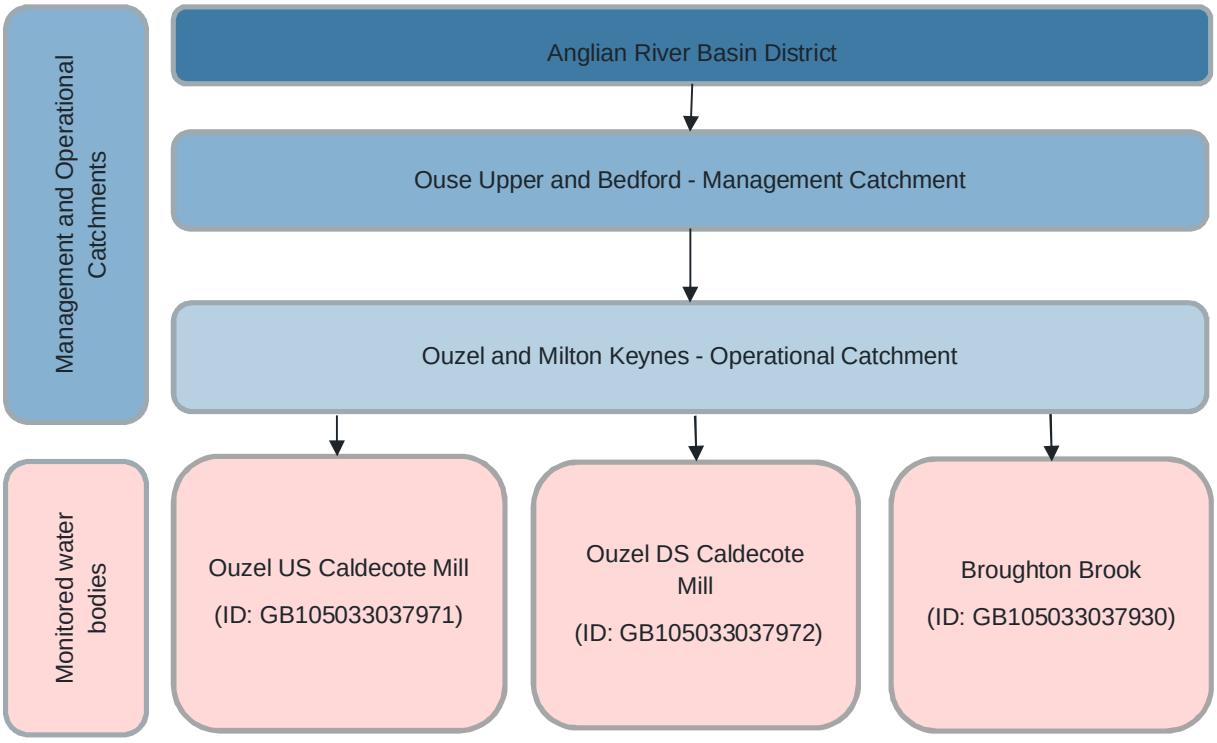



**Figure 4-1 - Catchments and water bodies relevant to the Scheme**

4.2.2. The Anglian River Basin District is 27,900km$^2$ and extends from Lincolnshire in the north to Essex in the south and from Northamptonshire in the west to the east Anglian coast. The river basin district is a predominantly rural catchment, with more than 50% of land used for agriculture and horticulture. There are urban centres predominantly in the upper catchment at Milton Keynes, Northampton, Bedford and Peterborough. The Ouse Upper and Bedford management catchment includes the catchment of the River Great Ouse, upstream of Huntingdon. The management catchment is split into five operational catchments, including the Ouzel and Milton Keynes operational catchment in which the Scheme is located.

4.2.3. There are three WFD water bodies within 1km of the Scheme which have been screened into this assessment, as per Section 2. Their WFD status is summarised below and the full WFD baseline data is presented in Appendix C.

**River Ouzel**

4.2.4. The River Ouzel is separated into three separate WFD water bodies, two of which are screened into this assessment: Ouzel US Caldecote Mill and Ouzel DS Caldecote.

4.2.5. Ouzel Us Caldecote Mill is a Heavily Modified Water Body currently performing at *Moderate* Overall Water Body status; comprising *Moderate* Ecological Status and *Fail* Chemical Status. The water body is currently not achieving *Good* due to physical modifications, sewage discharges and poor nutrient management within the catchment. The water body is not targeted to achieve *Good* status due to disproportional burdens and no known technical solution to the identified issues.

4.2.6. River Ouzel DS Caldecote Mill is a river water body, not designated as heavily modified, which is currently performing at *Moderate* Overall Water Body status; comprising *Moderate* Ecological Status and *Fail* Chemical Status. The water body is currently not achieving *Good* due to sewage discharges and poor nutrient management within the catchment. The water body is not targeted to achieve *Good* status due to the unfavourable balance between costs and benefits.

4.2.7. A summary of the baseline conditions for each of the WFD elements is presented in Table 4-1 and Table 4-2, for the two River Ouzel WFD water bodies.

**Table 4-1 - Baseline data for scoped-in WFD quality elements for River Ouzel US Caldecote Mill (GB105033037971)**

| WFD Quality Element | Baseline description |
|---|---|
| **Hydromorphology** | |
| Quantity and dynamics of flow | The watercourse is gauged at Willen (upstream of the Scheme) where it is recorded that the mean flow in the River Ouzel is 2m$^3$/s and a low flow ($Q_{95}$) of 0.46m$^3$/s.<br>At the location of the proposed Highway Link 107 crossing, the River Ouzel is modelled to experience velocities ranging from 1.4m/s in a 1 in 20-year flood event to 2.8 m/s in a 1 in 100-year flood event with 65% climate change allowance. |
| River Continuity | There are no blockages to migration of biota along the River Ouzel at the location of the Scheme. Immediately upstream of the Tongwell Street Road Bridge, the River Ouzel is heavily modified in association with the Willen Lakes flood management. Here the river is confined within a concrete channel with various structural features to dissipate energy and manage flow rates. At the downstream end of this water body is the Caldecote Mill which has a weir across the river.<br>The river is more natural through the Site and there is no impediment to lateral connection with the floodplain. |
| River depth and width variation | The width of the river at the proposed crossing location is approximately 10m with a 6m bed width. The width and depth are fairly uniform throughout the study reach with |

| WFD Quality Element | Baseline description |
|---|---|
| | pools and point bars creating depth variability at meander bends. |
| Structure and substrate of the riverbed | Sediment sampling has not been completed on this watercourse. |
| Structure of the riparian zone | Throughout the Site the river flows through its floodplain which has an agricultural land use. The riparian zone is mostly long grasses and bushes on the steep river bank with an approximate 3m grass strip between the river bank and the farmed floodplain, both extensive tilled land and pasture. There are a few mature trees individually spaced along the river corridor on both banks through the Site. |
| **Physico-chemical** | |
| Oxygenation conditions | *High* WFD status. |
| Temperature | *High* WFD status. |
| Acidification | *High* pH WFD status. |
| Nutrient conditions | *Poor* WFD status for Phosphates, *High* WFD status for Ammonia. |
| Specific pollutants | *High* WFD status for all monitored specific pollutants. |
| **Biological** | |
| Fish (composition, abundance and age of the fauna) | *High* WFD status |
| Benthic Invertebrates (composition and abundance of the fauna) | Good WFD status |
| **Chemical status** | |
| Overall chemical status | *Fail* |
| Priority substances | *Good* |
| Priority hazardous substances | *Fail* due to Polybrominated diphenyl ethers and Perfluorooctane sulphonate. |

**Table 4-2 - Baseline data for scoped-in WFD quality elements for River Ouzel DS Caldecote Mill (GB105033037972)**

| WFD Element | Baseline description |
|---|---|
| **Hydromorphology** | |
| Quantity and dynamics of flow | The watercourse is gauged at Willen (upstream of the Scheme) where it is recorded that the mean flow in the River Ouzel is 2m$^3$/s and a low flow ($Q_{95}$) of 0.46m$^3$/s.<br>At the location of the proposed Highway Link 107 crossing, the River Ouzel is modelled to experience velocities ranging from 1.4m/s in a 1 in 20-year flood event to 2.8 m/s in a 1 in 100-year flood event with 65% climate change allowance. |
| River Continuity | There are two weirs in this WFD water body which may pose a barrier to migration of biota along this watercourse: one at Caldecote Mill and the other at Tickford End.<br>The Ouzel downstream of Caldecote Mill flows through a semi-rural environment. In this reach the floodplain is developed on at least one bank and therefore lateral connection to the natural floodplain is minimised by this development. |
| River depth and width variation | The width of the river at the proposed crossing location is approximately 10m with a 6m bed width. The width and depth are fairly uniform throughout the study reach with pools and point bars creating depth variability at meander bends. |
| Structure and substrate of the riverbed | Sediment sampling has not been completed on this watercourse. |
| Structure of the riparian zone | This reach of the Ouzel flows through a semi-rural environment. Most of the right bank and floodplain in this reach is a recreation area, whilst the left bank is mostly agricultural land or gardens. The riparian zone is mostly long grasses and bushes on the steep river bank with an approximate 3m grass strip between the river bank and the farmed floodplain, both extensive tilled land and pasture. There are a few mature trees individually spaced along the river corridor on both banks through the reach. |
| **Physico-chemical** | |
| Oxygenation conditions | *High* WFD status. |
| Biochemical oxygen demand (BOD) | *High* WFD status. |
| Temperature | *High* WFD status. |
| Acidification | *High* pH WFD status. |

| WFD Element | Baseline description |
|---|---|
| Nutrient conditions | *Moderate* WFD status for Phosphates, *High* WFD status for Ammonia. |
| Specific pollutants | *High* WFD status for all monitored specific pollutants (not monitored since 2014). |
| **Biological** | |
| Fish (composition, abundance and age of the fauna) | *High* WFD status (not monitored since 2014). |
| Benthic Invertebrates (composition and abundance of the fauna) | *Good* WFD status |
| **Chemical status** | |
| Overall chemical status | *Fail* |
| Priority substances | *Good* |
| Priority hazardous substances | *Fail* due to Polybrominated diphenyl ethers and Perfluorooctane sulphonate. |

**Broughton Brook**

4.2.8. The Broughton Brook is a Heavily Modified Water Body currently performing at *Poor* Overall Water Body status; comprising *Poor* Ecological Status and *Fail* Chemical Status. The water body is currently not achieving *Good* due to physical modifications, groundwater abstractions, sewage discharges and poor nutrient management within the catchment. The water body is targeted to achieve *Good* status by 2027 and progress to date has been stunted by disproportionate burdens and unknown sources of impacts.

4.2.9. A summary of the baseline conditions for each of the WFD elements scoped into this assessment is presented in Table 4-3.

**Table 4-3 - Baseline data for scoped-in WFD quality elements for Broughton Brook (GB105033037930)**

| WFD Element | Baseline description |
|---|---|
| **Hydromorphology** | |
| Quantity and dynamics of flow | The Broughton Brook is gauged just upstream of the M1 crossing. The mean flow in the Broughton Brook at this location is 0.323$m^3$/s and the Q95 is 0.038$m^3$/s.<br>At the location of the Scheme, the Broughton Brook is modelled to experience velocities ranging from 1.1m/s in a 1 in 20 year flood event to 1.5 m/s in a 1 in 100-year flood event with 65% climate change allowance. |

| WFD Element | Baseline description |
|---|---|
| River Continuity | There are no blockages to migration of biota along the Broughton Brook at the location of the Scheme.<br>The brook is more natural through the Site and there is no impediment to lateral connection with the floodplain in this location |
| River depth and width variation | The width of the river is approximately 8 with a 3m bed width. The width and depth are fairly uniform throughout the study reach with pools and point bars creating depth variability at meander bends. |
| Structure and substrate of the riverbed | Sediment sampling has not been completed on this watercourse. |
| Structure of the riparian zone | For its limited reach within the Site the river flows through its floodplain which has an agricultural land use on the right bank and the Cotton Valley Sewage Treatment Works on the left hand bank (upstream of the M1) and the former motocross track (downstream of the M1). The riparian zone is mostly long grasses and bushes on the steep river bank with an approximate 3m grass strip between the river bank and the farmed floodplain, both extensive tilled land and pasture. The former motocross track is largely shrub. There are a few mature trees individually spaced along the river corridor on both banks through the Site.<br>Upstream of the Site, the brook flows through a linear park which has been designed to provide wet woodland riparian habitat. |
| **Physico-chemical** | |
| Oxygenation conditions | *High* WFD status. |
| Biochemical oxygen demand (BOD) | *Good* WFD status. |
| Temperature | *High* WFD status. |
| Acidification | *High* pH WFD status<br>*High* acid neutralising capacity |
| Nutrient conditions | Moderate WFD status for Phosphates, *High* WFD status for Ammonia. |
| Specific pollutants | *High* WFD status for all monitored specific pollutants. |
| **Biological** | |
| Aquatic flora (macrophytes) | *Poor* WFD status |
| Benthic Invertebrates (composition and abundance of the fauna) | *Good* WFD status |

| WFD Element | Baseline description |
|---|---|
| **Chemical status** | |
| Overall chemical status | *Fail* |
| Priority substances | *Good* |
| Priority hazardous substances | *Fail due to* Polybrominated diphenyl ethers. |

## WFD MEASURES

4.2.10. There are mitigation measures proposed for the Ouzel US Caldecote Mill WFD water body. These include the following:

- Remove obsolete structures;
- Preserve or restore habitats;
- In-channel morphology diversity;
- Floodplain connectivity;
- Fish passes;
- Changes to locks;
- Selective vegetation control;
- Invasive species techniques; and,
- Sediment management strategy.

4.2.11. The Broughton Brook is also a heavily modified water body however the Environment Agency has identified that mitigation measures are not applicable on this water body.

4.2.12. The River Ouzel DS Caldecote Mill is not a heavily modified water body and therefore there are no mitigation measures planned for this water body.

# 5 DETAILED IMPACT ASSESSMENT

## 5.1 STEP 1: POTENTIAL GENERIC OPERATIONAL IMPACTS OF THE SCHEME ON WFD QUALITY ELEMENTS

5.1.1. Potential pressures and impacts of the Scheme have been identified along with embedded mitigation measures and are presented in Table 5-1. The proposed mitigation thus forms the basis of this assessment.

**Table 5-1 - Pressures, potential impacts and associated mitigation for works to the impacted water bodies and downstream water bodies (Source: Annex IV: Flood Risk Management[6] )**

| Pressure | Sub-pressures | Potential Impacts | Mitigation Measures |
|---|---|---|---|
| Tongwell Street Road Bridge | Hard bank protection<br>Vegetation removal and die-back<br>Pier construction<br>Channel shading | Loss of morphological diversity and habitat<br>Hard protection and associated impacts<br>Loss of aquatic, marginal and riparian habitat<br>Initiation of geomorphic response | **Riparian habitat**<br>Enhancement of the riparian zone through a planting regime of appropriate species would offset the impacts of channel shading and subsequent loss of riparian habitat. This would have knock-on benefits for a range of receptors including fish and invertebrates.<br>**Floodplain Enhancement**<br>Allowing a greater frequency of floodplain connection, within the Scheme Extents would provide the conditions for a range of wetland species to thrive. This could be promoted further through an appropriate planting regime.<br>**Backwater Habitat**<br>Morphological and flow-type diversity would be introduced within the Scheme Extents through the creation of backwater habitats, installation of large wood within the backwaters, and willow spiling. These backwater habitats would provide mitigation for the proposed structures on the receptor waterbodies. |

[6] WFD UKTAG (2008) Guidance for defining Good Ecological Potential

| Pressure | Sub-pressures | Potential Impacts | Mitigation Measures |
|---|---|---|---|
| Highway Link 107 | Hard bank protection<br>Vegetation clearance/die-back<br>Abutment and embankment construction/ operation<br>Channel shading | Loss of morphological diversity and habitat<br>Bank protection and associated impacts<br>Loss of aquatic, marginal and riparian habitat<br>Flow constriction<br>Initiation of geomorphic response | **Riparian habitat**<br>Enhancement of the riparian zone through a planting regime of appropriate species would offset the impacts of channel shading and subsequent loss of riparian habitat. This would have knock-on benefits for a range of receptors including fish and invertebrates.<br>**Floodplain Enhancement**<br>Allowing a greater frequency of floodplain connection would provide the conditions for a range of wetland species to thrive. This could be promoted further through an appropriate planting regime.<br>**Backwater Habitat**<br>Morphological and flow-type diversity would be introduced through the creation of backwater habitats, installation of large wood within the backwaters, and willow spiling. These backwater habitats would provide mitigation for the proposed structures on the receptor waterbodies. |
| Moulsoe Brook Culvert Replacement | In-channel structure<br>Outfall structure | Loss of morphological diversity and habitat<br>Hard protection and associated impacts<br>Impediment to fish/mammal passage and ecological connectivity<br>Loss of aquatic, marginal and riparian habitat<br>Initiation of geomorphic response | **Riparian habitat**<br>Subject to IDB agreement the riparian zone would be enhanced through a planting regime of appropriate species would offset the impacts of channel shading and subsequent loss of riparian habitat. This would have knock-on benefits for a range of receptors including fish and invertebrates.<br>**Wet woodland habitat**<br>If feasible allowing a greater frequency of floodplain connection would provide the conditions for a range of wetland species to thrive. This could be promoted further through an appropriate planting regime.<br>**Backwater Habitat**<br>Within the Scheme Extents morphological and flow-type diversity would be introduced through the creation of backwater habitats, |

| Pressure | Sub-pressures | Potential Impacts | Mitigation Measures |
|---|---|---|---|
| | | | installation of large wood within the backwaters, and willow spiling. These backwater habitats would provide mitigation for the proposed structures on the receptor waterbodies. |
| Moulsoe Brook Highway Crossing | Vegetation removal and die-back<br>Channel shading | Loss of morphological diversity and habitat<br>Loss of aquatic, marginal and riparian habitat | **Riparian habitat**<br>Enhancement of the riparian zone, within the Scheme Extents through a planting regime of appropriate species would offset the impacts of channel shading and subsequent loss of riparian habitat. This would have knock-on benefits for a range of receptors including fish and invertebrates.<br>**Wet woodland habitat**<br>If feasible allowing a greater frequency of floodplain connection would provide the conditions for a range of wetland species to thrive. This could be promoted further through an appropriate planting regime.<br>**Backwater Habitat**<br>Within the Scheme Extents morphological and flow-type diversity would be introduced through the creation of backwater habitats, installation of large wood within the backwaters, and willow spiling. These backwater habitats would provide mitigation for the proposed structures on the receptor waterbodies. |
| Surface Water Drainage | Road drainage | Fish and macroinvertebrate mortality through fine sediment release and introduction of harmful compounds. | **SuDS**<br>Sustainable Drainage Systems (SuDS) would remove harmful silts and compounds derived from highway drainage and prevent them from entering the local surface water and ground water bodies.<br>Embedded mitigation within the design of outfalls would ensure water quality standards are met. The HEWRAT assessment conducted by WSP (appended to the Environmental Statement) demonstrates a sufficient reduction in key pollutants so as to avoid adversely impacting upon water quality within the receptor watercourses. The incorporation of |

| Pressure | Sub-pressures | Potential Impacts | Mitigation Measures |
|---|---|---|---|
| | | | SuDS would ensure compliance with WFD water quality objectives, where the HEWRAT assessment identified that mitigation was required to manage the risk of sediment bound pollutants and solutes. In addition, the spillage risk assessment calculated that the probability of a spillage event with the potential to pollute watercourses occurring was to an acceptable level across the scheme. Outfalls would be designed to control the risk of scour to the bed and banks if necessary, thus preventing the increase in fine sediment load and associated pollutants. |
| Vegetation clearing | Loss of riparian and floodplain habitat | Loss of marginal and riparian habitat. Loss of floodplain habitat functioning | **Vegetation replacement**<br>Riparian vegetation and trees would be replaced elsewhere through compensatory habitat creation. Green engineering approaches would be sought where river banks could be left susceptible to erosion, with willow spiling proposed as a potential suitable option. |

## 5.2 STEP 2: SITE SPECIFIC ASSESSMENT OF THE SCHEME AGAINST WFD QUALITY ELEMENTS

**The site-specific impacts of the Scheme on the biological, physico-chemical and hydromorphological quality elements of the water bodies are provided in Table 5-2 to**

5.2.1. Table 5-4.

**Table 5-2 - Assessment of impact to WFD quality elements during the operation phase for the Ouzel US Caldecote Mill**

| Quality Element | Potential Impacts | Mitigation |
|---|---|---|
| **Water body ID** | GB105033037971 | |
| **Water body name** | Ouzel US Caldecote Mill | |
| **Hydromorphological Quality Elements** | | |
| Quantity and dynamics of flow | **Highway Link 107**<br>The bridge abutments have been designed to be set back from bank top to both limit the throttling effect caused by flow constriction and maintain conveyance; however, the abutments would still be within the flooded zone during out-of-bank events and thus would have an influence on the quantity and dynamics of flow during high magnitude, low-frequency floods.<br>However, the proposed road embankment may have a similar throttling effect during extreme floods; it will therefore likely a impart localised influence on flow, all be it intermittently, during low-frequency events. | **Highway Link 107**<br>Backwater habitat creation would be implemented to offset the impacts on quantity and dynamics of flow. These features would connect during elevated flow events to create niche habitat, hydraulic variation and fish refuge. |
| | **Moulsoe Brook Culvert Replacement**<br>The proposed culvert replacement could continue to impart a detrimental influence on the quantity and dynamics of flow within Moulsoe Brook. However, the watercourse is ephemeral and therefore probably does not support a population of fish and invertebrates; therefore, impacts of the structure are not likely to affect quantity and dynamics of flow at the water body scale. | **Moulsoe Brook Culvert Replacement**<br>Impacts of the culvert would be offset through riparian enhancement along the watercourse corridor where practicable and within the redline boundary. |

| Quality Element | Potential Impacts | Mitigation |
|---|---|---|
| | **Surface Water Drainage**<br>Increased runoff due to stripped land could lead to a detrimental change to flow dynamics and quantity. The proposed outfalls may initiate bed scour downstream through discharge of drainage water, thereby having the potential to impact upon the quantity and dynamics of flow within the watercourse. | **Surface Water Drainage**<br>Drainage would be intercepted by SuDS features such as swales and wetlands. Floodplain planting would be implemented to generate roughness and prevent rapid runoff. Riparian planting would be implemented within the linear park to offset the direct loss of habitat brought about by construction of outfalls. Appropriate scour protection would be implemented within the design of the outfalls if required (to be determined at a later phase). This would avoid changes to channel geometry and thus would eliminate impacts upon longitudinal connectivity. |
| River continuity | **Highway Link 107**<br>The bridge abutments have been designed to be set back from bank top to limit the throttling effect caused by flow constriction and maintain conveyance; however, the abutments would still be within the flooded zone during out-of-bank events and thus could have an influence on lateral connectivity. | **Highway Link 107**<br>Backwater habitat creation would be implemented to offset the impacts on river continuity. These features would connect during elevated flow events to create niche habitat, hydraulic variation and fish refuge. |
| | **Moulsoe Brook Culvert Replacement**<br>The proposed replacement of the 19m culvert with a 21m culvert could continue to impart a detrimental influence on river continuity within Moulsoe Brook. However, the watercourse is ephemeral and therefore probably does not support a population of fish and, possibly, invertebrates; therefore, impacts of the structure replacement are not likely to affect river continuity at the water body scale, or degrade the ephemeral stream beyond its present condition. | **Moulsoe Brook Culvert Replacement**<br>None required. |

| Quality Element | Potential Impacts | Mitigation |
|---|---|---|
| River depth and width variation | **Tongwell Street Road Bridge**<br>This component of the Scheme would result in a direct loss of riparian habitat through construction of the bridge piers, while the bridge deck would have a considerable shading impact, leading to additional riparian vegetation habitat losses. | **Tongwell Street Road Bridge**<br>Impacts of the bridge would be offset through riparian enhancement along the watercourse corridor, within the linear park, where practicable and within the redline boundary. In addition, backwater features would provide niche habitat and fish refuge, and floodplain enhancements, such as wetland creation and planting would enhance the wider Ouzel system within the Scheme boundary. |
| | **Highway Link 107**<br>The bridge abutments have been designed to be set back from bank top to limit the throttling effect caused by flow constriction and maintain conveyance; however, the abutments would still be within the flooded zone during out-of-bank events and thus could have an influence on width and depth variation over time.<br>River bank erosion may be exacerbated downstream of the proposed embankment structure due to flow constriction and increased velocity. This would have an impact upon the width and depth variation of the watercourse. | **Highway Link 107**<br>Backwater habitat creation would be implemented to offset the impacts on river continuity. These features would connect during elevated flow events to create niche habitat, hydraulic variation and fish refuge.<br>Bank protection would be implemented where necessary. This would take the form of green engineering solutions, such as tree planting or willow spiling, for example, where practicable. |
| | **Moulsoe Brook Culvert Replacement**<br>The proposed replacement of the 19m culvert with a 21m culvert would continue to impart a detrimental influence on river width and depth variation within Moulsoe Brook. However, the watercourse is ephemeral and therefore probably does not support a population of fish and, possibly, invertebrates; therefore, impacts of the structure replacement on this quality element are not likely to affect | **Moulsoe Brook Culvert Replacement**<br>The impacts of the culverts would be offset through riparian enhancement along the watercourse corridor where practicable and within the redline boundary. Fish and eel passage is not necessary due to the ephemeral flow regime of the watercourse. |

| Quality Element | Potential Impacts | Mitigation |
|---|---|---|
| | width and depth variation at the water body scale, or degrade the ephemeral stream beyond its present condition. | |
| | **Moulsoe Brook Highway Crossing**<br>The proposed new Tongwell Street Bridge would potentially impart flow constriction during peak flow events, which could lead to a pinch point. This, in turn, could have an influence on width and depth variation of the watercourse; however, this would be localised and, given the ephemeral flow characteristics of the watercourse, would have very limited impact, particularly at the water body scale. | **Moulsoe Brook Highway Crossing**<br>Impacts of the crossing would be offset through riparian enhancement along the watercourse corridor where practicable and within the redline boundary. |
| | **Surface Water Drainage**<br>Surface water drainage may provide pathways for fine material to enter the channel and gradually accumulate, leading to a detrimental impact on width and depth variation. The proposed outfalls may initiate bed scour at their outlet, thereby having the potential to alter bedform and thus impact upon the depth variation within the watercourse. | **Surface Water Drainage**<br>Drainage will be treated in SuDS such as swales and wetlands. Floodplain planting would be implemented to intercept fines and bind soils to avoid runoff. Appropriate scour protection would be implemented within the design of the outfalls if required (to be determined at a later phase). This would avoid changes to channel geometry and thus would eliminate impacts upon river width and depth variation. |
| Structure and substrate of the river bed | **Tongwell Street Road Bridge**<br>Additional flow constriction during flood events could lead to bed scour and thus alter the substrate's composition and character. | **Tongwell Street Road Bridge**<br>Impacts of the bridge structure would be offset through extensive riparian enhancement along the watercourse corridor where practicable and within the redline boundary. |
| | **Highway Link 107** | **Highway Link 107**<br>The bridge abutments have been designed to be set back as far as practicable to limit flow constriction and maintain |

| Quality Element | Potential Impacts | Mitigation |
|---|---|---|
| | Flow constriction during flood events could lead to bed scour and thus alter the substrate's composition and character. | lateral connectivity. Riparian planting and the proposed backwater features would offset local impacts of the structure. |
| | **Moulsoe Brook Culvert Replacement**<br>The proposed online culvert replacement could surcharge during elevated flow. In turn, this could lead to sediments being accelerated through the structure leading to an adverse morphological response downstream. Similarly, during such events, water could back-up behind structure inlets and lead to sediment deposition upstream of structures. | **Moulsoe Brook Culvert Replacement**<br>Impacts of the culvert would be offset through riparian enhancement along the watercourse corridor where practicable and within the redline boundary. |
| | **Moulsoe Brook Highway Crossing**<br>Flow constriction during flood events could lead to bed scour and thus alter the substrate's composition and character. | **Moulsoe Brook Highway Crossing**<br>Impacts of the crossing would be offset through riparian enhancement along the watercourse corridor where practicable and within the redline boundary. |
| | **Surface Water Drainage**<br>Increased sediment runoff could smother the existing river substrate and detrimentally alter the structure and substrate of the river bed. The proposed outfalls may initiate bed scour downstream through discharge of drainage water, thereby having the potential to impact upon the quantity and dynamics of flow within the watercourse. | **Surface Water Drainage**<br>Floodplain planting would reduce sediment runoff, while SuDS features such as swales and wetlands would intercept fines. In addition, riparian planting would act as a buffer zone between the channel and its floodplain to further prevent fines from entering the watercourse. Appropriate scour protection would be implemented within the design of the outfalls if required (to be determined at a later phase). This would avoid changes to channel geometry and thus would confine impacts upon the structure and substrate of the river bed to a small area. |
| Structure of the riparian zone | **Tongwell Street Road Bridge** | **Tongwell Street Road Bridge** |

| Quality Element | Potential Impacts | Mitigation |
|---|---|---|
| | Shading impacts of the bridge would eliminate existing riparian habitat underneath the bridge deck. Moreover, the design includes abutments that essentially form the banks; thus, removing the opportunity of riparian enhancement at the bridge location. | Riparian habitat enhancement would be implemented elsewhere within the study reach (i.e. the linear park), ideally as local to the zone of impact as possible (though there are opportunities for enhancement throughout). This would take the form of an appropriate planting regime |
| | **Highway Link 107**<br>Shading impacts of the bridge would eliminate existing riparian habitat underneath the bridge deck, thus removing the opportunity of riparian enhancement at the bridge location.<br>River bank erosion may be exacerbated downstream of the proposed embankment structure due to flow constriction and increased velocity. This would have an impact upon the structure of the riparian zone. | **Highway Link 107**<br>Riparian habitat enhancement would be implemented elsewhere within the study reach, ideally as local to the zone of impact as possible (though there are opportunities for enhancement throughout). This would take the form of an appropriate planting regime.<br>Bank protection would be implemented where necessary. This would take the form of green engineering solutions, such as tree planting or willow spiling, for example, where practicable. |
| | **Moulsoe Brook Culvert Replacement**<br>The existing culvert already imparts a significant detrimental effect on the riparian zone within the immediate vicinity of the structure. As such, the proposed culvert replacement would not exert an additional impact over and above existing conditions on this quality element. | **Moulsoe Brook Culvert Replacement**<br>Riparian habitat enhancement would be implemented elsewhere within the study reach, ideally as local to the zone of impact as possible (though there are opportunities for enhancement throughout). This would take the form of an appropriate planting regime |
| | **Moulsoe Brook Highway Crossing**<br>The proposed new Tongwell Street Bridge would potentially lead to a loss in riparian habitat due to the influence of shading. | **Moulsoe Brook Highway Crossing**<br>Riparian habitat enhancement would be implemented elsewhere within the study reach, ideally as local to the zone of impact as possible (though there are opportunities for enhancement throughout). This would take the form of an appropriate planting regime |

| Quality Element | Potential Impacts | Mitigation |
|---|---|---|
| | | |
| **Physico-chemical Quality Elements** | | |
| Oxygenation conditions | **Surface Water Drainage**<br>There is potential for an increase in biochemical oxygen demand as a result of increased road run-off entering the watercourse. Construction of wing-walled structures within close proximity to the channel would result in a direct loss of riparian habitat. | **Surface Water Drainage**<br>Embedded mitigation within the design of Sustainable Urban Drainage Systems (SuDS) and outfalls would ensure water quality standards are met. The HEWRAT assessment conducted by WSP demonstrates a sufficient reduction in key pollutants so as not to adversely impact upon water quality within the watercourse. Riparian enhancements would be incorporated to the planting regime described previously. |
| Acidification | **Surface Water Drainage**<br>There is potential for an increase in acidity as a result of increased road run-off entering the watercourse. However, the risk would be minimised due to the hard to very hard water of the region; meaning that the potential for acidification would be reduced by the buffering capacity of the watercourse's natural water quality. | **Surface Water Drainage**<br>Embedded mitigation within the design of Sustainable Urban Drainage Systems (SuDS) and outfalls would ensure water quality standards are met. The HEWRAT assessment conducted by WSP demonstrates a sufficient reduction in key pollutants so as not to adversely impact upon water quality within the watercourse. |
| Nutrient conditions | **Surface Water Drainage**<br>There is potential for an increase in ammonia and nitrates as a result of increased road run-off entering | **Surface Water Drainage**<br>Embedded mitigation within the design of Sustainable Urban Drainage Systems (SuDS) and outfalls would ensure water quality standards are met. The HEWRAT assessment conducted by WSP demonstrates a sufficient reduction in key pollutants so as not to adversely impact upon water quality within the watercourse. |
| Specific pollutants | **Surface Water Drainage** | **Surface Water Drainage** |

| Quality Element | Potential Impacts | Mitigation |
|---|---|---|
| | There is potential for an increase in specific pollutants as a results of increased road run-off entering the watercourse. | Embedded mitigation within the design of Sustainable Urban Drainage Systems (SuDS) and outfalls would ensure water quality standards are met. The HEWRAT assessment conducted by WSP demonstrates a sufficient reduction in key pollutants so as not to adversely impact upon water quality within the watercourse. |
| **Biological Quality Elements** | | |
| Fish | **Tongwell Street Road Bridge**<br>The bridge structure would affect the composition of the aquatic habitat beneath and in the immediate vicinity of the crossing. This would principally be through the effects of shading and subsequent loss of macrophytes from the river and riparian areas in that location, and associated changes in the structure and composition of the river bed material. This could affect shelter and prey availability for fish. | **Tongwell Street Road Bridge**<br>The proposed backwaters and riparian enhancements would compensate for any localised changes in the aquatic habitat brought about by the construction of the clear-span bridge and consequent shading, by improving and diversifying the available habitats and ecological niches.<br>The clear-span design of the bridge will eliminate the need for structures within the channel which would affect flow. |
| | **Highway Link 107**<br>The bridge structure would affect the composition of the aquatic habitat beneath and in the immediate vicinity of the crossing. This would principally be through the effects of shading and subsequent loss of macrophytes from the river and riparian areas in that location, and associated changes in the structure and composition of the river bed material. This could affect shelter and prey availability for fish species present. | **Highway Link 107**<br>The proposed backwaters and riparian enhancements would compensate for any localised changes in the aquatic habitat brought about by the construction of the clear-span bridge and consequent shading, by improving and diversifying the available habitats and ecological niches.<br>The clear-span design of the bridge will eliminate the need for structures within the channel which would affect flow. |
| | **Moulsoe Brook Culvert Replacement** | **Moulsoe Brook Culvert Replacement** |

| Quality Element | Potential Impacts | Mitigation |
|---|---|---|
| | Moulsoe Brook is ephemeral and is unlikely to support a resident population of fish, therefore, impacts of the structure replacement on this quality element are not likely to degrade the ephemeral stream beyond its present condition. | The online culvert would be designed with embedded mitigation features such as a depressed invert and a natural substrate bed. The impacts of the culverts would be offset through extensive riparian enhancement along the watercourse corridor where practicable and within the redline boundary. |
| | **Moulsoe Brook Highway Crossing**<br>The new bridge structure would affect the composition of the aquatic habitat beneath and in the immediate vicinity of the crossing. This would principally be through the effects of shading and subsequent loss of macrophytes from the river and riparian areas in that location, and associated changes in the structure and composition of the river bed material. This could affect shelter and prey availability for fish species present. | **Moulsoe Brook Highway Crossing**<br>Riparian habitat enhancement would be implemented elsewhere within the study reach, ideally as local to the zone of impact as possible (though there are opportunities for enhancement throughout). This would take the form of an appropriate planting regime to aid in diversifying the available habitat and ecological niches.<br>The clear-span design of the bridge will eliminate the need for structures within the channel which would affect flow. |
| | **Surface Water Drainage**<br>There is potential for increased road run-off entering the watercourse which could result in changes to water quality and increased pollution incidents.<br>Road run-off could contain elevated levels of pollutants such as hydrocarbons, salt and/or sediment. These could reduce water quality and smother the channel bed. Fish could be directly and indirectly affected by such changes through the degradation of spawning habitat and reduced water quality or toxicity. | **Surface Water Drainage**<br>Embedded mitigation within the design of Sustainable Urban Drainage Systems (SuDS) and outfalls would ensure water quality standards are met. The HEWRAT assessment conducted by WSP demonstrates a sufficient reduction in key pollutants so as not to adversely impact upon water quality within the watercourse. |
| Aquatic macroinvertebrates | **Tongwell Street Road Bridge**<br>The bridge structure has the potential to impact on the structure of the aquatic habitat beneath and in the | **Tongwell Street Road Bridge**<br>The proposed backwaters and riparian enhancements would compensate for any localised changes in the benthic |

| Quality Element | Potential Impacts | Mitigation |
|---|---|---|
| | immediate vicinity of the crossing. This would principally be through the effects of shading and subsequent loss of macrophytes from the river and riparian areas in that location, and associated changes in the structure and composition of the river bed material. This would directly affect the composition of the benthic macroinvertebrate community in this area as well as limiting habitat and prey availability. | macroinvertebrate community brought about by the construction of the clear-span bridge, by improving and diversifying the available habitats and ecological niches.<br><br>The clear-span design of the bridge will eliminate the need for structures within the channel which would affect flow. |
| | **Highway Link 107**<br><br>The bridge structure has the potential to impact on the structure of the aquatic habitat beneath and in the immediate vicinity of the crossing. This would principally be through the effects of shading and subsequent loss of macrophytes from the river and riparian areas in that location, and associated changes in the structure and composition of the river bed material. This would directly affect the composition of the benthic macroinvertebrate community in this area as well as limiting habitat and prey availability. | **Highway Link 107**<br><br>The proposed backwaters and riparian enhancements would compensate for any localised changes in the benthic macroinvertebrate community brought about by the construction of the clear-span bridge, by improving and diversifying the available habitats and ecological niches.<br><br>The clear-span design of the bridge will eliminate the need for structures within the channel which would affect flow. |
| | **Moulsoe Brook Culvert Replacement**<br><br>The proposed replacement of the 19m with a 21m culvert replacement would continue to influence on available habitat and ecological niches within Moulsoe Brook. Impacts of the structure replacement on this quality element are not likely to affect the habitat at the water body scale or degrade the ephemeral stream beyond its present condition. | **Moulsoe Brook Culvert Replacement**<br><br>The impacts of the culvert would be offset through extensive riparian enhancement along the watercourse corridor where practicable and within the redline boundary. |
| | **Moulsoe Brook Highway Crossing** | **Moulsoe Brook Highway Crossing** |

| Quality Element | Potential Impacts | Mitigation |
|---|---|---|
| | The new bridge structure would affect the composition of the aquatic habitat beneath and in the immediate vicinity of the crossing. This would principally be through the effects of shading and subsequent loss of macrophytes from the river and riparian areas in that location, and associated changes in the structure and composition of the river bed material. This would directly affect the composition of the benthic macroinvertebrate community in this area as well as limiting habitat and prey availability. | Riparian habitat enhancement would be implemented elsewhere within the study reach, ideally as local to the zone of impact as possible (though there are opportunities for enhancement throughout). This would take the form of an appropriate planting regime to aid in diversifying the available habitat and ecological niches. |
| | **Surface Water Drainage**<br><br>There is potential for increased road run-off entering the watercourse which could result in changes to water quality and increased pollution incidents.<br><br>Road run-off could contain elevated levels of pollutants such as hydrocarbons, salt and/or sediment. These could reduce water quality and smother the channel bed. Aquatic macroinvertebrates could be directly and indirectly affected by such changes through smothering, reduced water quality, degradation in feeding habitat and available refugia. | **Surface Water Drainage**<br><br>Embedded mitigation within the design of Sustainable Urban Drainage Systems (SuDS) and outfalls would ensure water quality standards are met. The HEWRAT assessment conducted by WSP demonstrates a sufficient reduction in key pollutants so as not to adversely impact upon water quality within the watercourse. |

**Table 5-3 - Assessment of impact to WFD quality elements during the operation phase for the Ouzel DS Caldecote Mill**

| Quality Element | Potential Impact | Mitigation |
|---|---|---|
| **Water body ID** | GB105033037972 | |
| **Water body name** | Ouzel US Caldecote Mill | |
| **Hydromorphological Quality Elements** | | |
| Quantity and dynamics of flow | **Highway Link 107**<br>The bridge abutments have been designed to be set back from bank top to both limit the throttling effect caused by flow constriction and maintain conveyance; however, the abutments would still be within the flooded zone during out-of-bank events and thus would have an influence on the quantity and dynamics of flow during high magnitude, low-frequency floods.<br>However, the proposed road embankment may have a similar throttling effect during extreme flood. While its design purpose is to reduce downstream flooding, it will likely a impart localised influence on flow, all be it intermittently, during low-frequency events. | **Highway Link 107**<br>Backwater habitat creation would be implemented to offset the impacts on quantity and dynamics of flow. These features would connect during elevated flow events to create niche habitat, hydraulic variation and fish refuge. |
| | **Moulsoe Brook Culvert Replacement**<br>The proposed culvert replacement could continue to impart a detrimental influence on the quantity and dynamics of flow within Moulsoe Brook. However, the watercourse is ephemeral and therefore probably does not support a population of fish and invertebrates; therefore, impacts of the structure are not likely to affect quantity and dynamics of flow at the water body scale. | **Moulsoe Brook Culvert Replacement**<br>Impacts of the culvert replacement are not anticipated to extend beyond the Moulsoe Brook watercourse. However, Impacts of the culvert would be offset through riparian enhancement along the watercourse corridor where practicable and within the redline boundary. |

| Quality Element | Potential Impact | Mitigation |
|---|---|---|
| | **Surface Water Drainage**<br>Increased runoff due to stripped land could lead to a detrimental change to flow dynamics and quantity. The proposed outfalls may initiate bed scour downstream through discharge of drainage water, thereby having the potential to impact upon the quantity and dynamics of flow within the watercourse. | **Surface Water Drainage**<br>Drainage would be intercepted by SuDS features such as swales and wetlands. Floodplain planting would be implemented to generate roughness and prevent rapid runoff. Riparian planting would be implemented elsewhere in the reach to offset the direct loss of habitat brought about by construction of outfalls. Appropriate scour protection would be implemented within the design of the outfalls if required (to be determined at a later phase). This would avoid changes to channel geometry and thus would eliminate impacts upon longitudinal connectivity. |
| River continuity | **Highway Link 107**<br>The bridge abutments have been designed to be set back from bank top to limit the throttling effect caused by flow constriction and maintain conveyance; however, the abutments would still be within the flooded zone during out-of-bank events and thus could have an influence on lateral connectivity. | **Highway Link 107**<br>Backwater habitat creation would be implemented to offset the impacts on river continuity. These features would connect during elevated flow events to create niche habitat, hydraulic variation and fish refuge. |
| | **Moulsoe Brook Culvert Replacement**<br>The proposed 21m culvert replacement could continue to impart a detrimental influence on river continuity within Moulsoe Brook. However, the watercourse is ephemeral and therefore probably does not support a population of fish and, possibly, invertebrates; therefore, impacts of the structure replacement are not likely to affect river continuity at the water body scale, or degrade the ephemeral stream beyond its present condition. | **Moulsoe Brook Culvert Replacement**<br>None required. |

| Quality Element | Potential Impact | Mitigation |
|---|---|---|
| River depth and width variation | **Tongwell Street Road Bridge**<br>This component of the Scheme would result in a direct loss of riparian habitat through construction of the bridge piers, while the bridge deck would have a considerable shading impact, leading to additional riparian vegetation habitat losses. | **Tongwell Street Road Bridge**<br>Impacts of the bridge would be offset through extensive riparian enhancement along the watercourse corridor where practicable and within the redline boundary. In addition, backwater features would provide niche habitat and fish refuge, and floodplain enhancements, such as wetland creation and planting would enhance the wider Ouzel system within the Scheme boundary. |
| | **Highway Link 107**<br>The bridge abutments have been designed to be set back from bank top to limit the throttling effect caused by flow constriction and maintain conveyance; however, the abutments would still be within the flooded zone during out-of-bank events and thus could have an influence on width and depth variation over time. The flow constriction influence of the road embankment could lead to bed scour and bank erosion. | **Highway Link 107**<br>Backwater habitat creation would be implemented to offset the impacts on River depth and width variation. These features would connect during elevated flow events to create niche habitat, hydraulic variation and fish refuge. |
| | **Moulsoe Brook Culvert Replacement**<br>The proposed 21m culvert replacement would continue to impart a detrimental influence on river width and depth variation within Moulsoe Brook. However, the watercourse is ephemeral and therefore probably does not support a population of fish and, possibly, invertebrates; therefore, impacts of the structure replacement on this quality element are not likely to affect width and depth variation at the water body scale, or degrade the ephemeral stream beyond its present condition. | **Moulsoe Brook Culvert Replacement**<br>The impacts of the culverts would be offset through extensive riparian enhancement along the watercourse corridor where practicable and within the redline boundary. Fish and eel passage is not necessary due to the ephemeral flow regime of the watercourse. |

| Quality Element | Potential Impact | Mitigation |
|---|---|---|
| | **Moulsoe Brook Highway Crossing**<br>The proposed new Tongwell Street Bridge would potentially impart flow constriction during peak flow events, which could lead to a pinch point. This, in turn, could have an influence on width and depth variation of the watercourse; however, this would be localised and, given the ephemeral flow characteristics of the watercourse, would have very limited impact, particularly at the water body scale. | **Moulsoe Brook Highway Crossing**<br>Impacts of the crossing would be offset through extensive riparian enhancement along the watercourse corridor where practicable and within the redline boundary. |
| | **Surface Water Drainage**<br>Surface water drainage may provide pathways for fine material to enter the channel and gradually accumulate, leading to a detrimental impact on width and depth variation. The proposed outfalls may initiate bed scour at their outlet, thereby having the potential to alter bedform and thus impact upon the depth variation within the watercourse. | **Surface Water Drainage**<br>Drainage will be treated in SuDS such as swales and wetlands. Floodplain planting would be implemented to intercept fines and bind soils to avoid runoff. Appropriate scour protection would be implemented within the design of the outfalls if required (to be determined at a later phase). This would avoid changes to channel geometry and thus would eliminate impacts upon river width and depth variation. |
| Structure and substrate of the river bed | **Tongwell Street Road Bridge**<br>Additional flow constriction during flood events could lead to bed scour and thus alter the substrate's composition and character. | **Tongwell Street Road Bridge**<br>Impacts of the bridge structure would be offset through riparian enhancement along the watercourse corridor where practicable and within the redline boundary. |
| | **Highway Link 107**<br>Flow constriction during flood events could lead to bed scour and thus alter the substrate's composition and character. | **Highway Link 107**<br>The bridge abutments have been designed to be set back as far as practicable to limit flow constriction and maintain lateral connectivity. Riparian planting and the proposed backwater features would offset local impacts of the structure. |

| Quality Element | Potential Impact | Mitigation |
|---|---|---|
| | **Moulsoe Brook Culvert Replacement**<br>The proposed online culvert replacement could surcharge during elevated flow. In turn, this could lead to sediments being accelerated through the structure leading to an adverse morphological response downstream. Similarly, during such events, water could back-up behind structure inlets and lead to sediment deposition upstream of structures. | **Moulsoe Brook Culvert Replacement**<br>Impacts of the culvert would be offset through riparian enhancement along the watercourse corridor where practicable and within the redline boundary. |
| | **Moulsoe Brook Highway Crossing**<br>Flow constriction during flood events could lead to bed scour and thus alter the substrate's composition and character. | **Moulsoe Brook Highway Crossing**<br>Impacts of the crossing would be offset through extensive riparian enhancement along the watercourse corridor where practicable and within the redline boundary. |
| | **Surface Water Drainage**<br>Increased sediment runoff could smother the existing river substrate and detrimentally alter the structure and substrate of the river bed. The proposed outfalls may initiate bed scour downstream through discharge of drainage water, thereby having the potential to impact upon the quantity and dynamics of flow within the watercourse. | **Surface Water Drainage**<br>Floodplain planting would reduce sediment runoff, while SuDS features such as swales and wetlands would intercept fines. In addition, riparian planting would act as a buffer zone between the channel and its floodplain to further prevent fines from entering the watercourse. Appropriate scour protection would be implemented within the design of the outfalls if required (to be determined at a later phase). This would avoid changes to channel geometry and thus would confine impacts upon the structure and substrate of the river bed to a small area. |
| Structure of the riparian zone | **Tongwell Street Road Bridge**<br>Shading impacts of the bridge would eliminate existing riparian habitat underneath the bridge deck. Moreover, the design includes abutments that essentially form the banks; | **Tongwell Street Road Bridge**<br>Riparian habitat enhancement would be implemented elsewhere within the study reach, ideally as local to the zone of impact as possible (though there are opportunities |

| Quality Element | Potential Impact | Mitigation |
|---|---|---|
| | thus, removing the opportunity of riparian enhancement at the bridge location. | for enhancement throughout). This would take the form of an appropriate planting regime |
| | **Highway Link 107**<br>Shading impacts of the bridge would eliminate existing riparian habitat underneath the bridge deck, thus removing the opportunity of riparian enhancement at the bridge location. | **Highway Link 107**<br>Riparian habitat enhancement would be implemented elsewhere within the study reach, ideally as local to the zone of impact as possible (though there are opportunities for enhancement throughout). This would take the form of an appropriate planting regime |
| | **Moulsoe Brook Culvert Replacement**<br>The existing culvert already imparts a significant detrimental effect on the riparian zone within the immediate vicinity of the structure. As such, the proposed culvert replacement would not exert an additional impact over and above existing conditions on this quality element. | **Moulsoe Brook Culvert Replacement**<br>Riparian habitat enhancement would be implemented elsewhere within the study reach, ideally as local to the zone of impact as possible (though there are opportunities for enhancement throughout). This would take the form of an appropriate planting regime |
| | **Moulsoe Brook Highway Crossing**<br>The proposed new Moulsoe Brook Highway Crossing would potentially lead to a loss in riparian habitat due to the influence of shading. | **Moulsoe Brook Highway Crossing**<br>Riparian habitat enhancement would be implemented elsewhere within the study reach, ideally as local to the zone of impact as possible (though there are opportunities for enhancement throughout). This would take the form of an appropriate planting regime. |
| **Physico-chemical Quality Elements** | | |
| Oxygenation conditions | **Surface Water Drainage**<br>There is potential for an increase in biochemical oxygen demand as a result of increased road run-off entering the watercourse. Construction of wing-walled structures within | **Surface Water Drainage**<br>Embedded mitigation within the design of Sustainable Urban Drainage Systems (SuDS) and outfalls would ensure water quality standards are met. The HEWRAT assessment conducted by WSP demonstrates a sufficient reduction in |

| Quality Element | Potential Impact | Mitigation |
|---|---|---|
| | close proximity to the channel would result in a direct loss of riparian habitat. | key pollutants so as not to adversely impact upon water quality within the watercourse. Riparian enhancements would be incorporated to the planting regime described previously. |
| Acidification | **Surface Water Drainage**<br>There is potential for an increase in acidity as a result of increased road run-off entering the watercourse. However, the risk would be minimised due to the hard to very hard water of the region; meaning that the potential for acidification would be reduced by the buffering capacity of the watercourse's natural water quality. | **Surface Water Drainage**<br>Embedded mitigation within the design of Sustainable Urban Drainage Systems (SuDS) and outfalls would ensure water quality standards are met. The HEWRAT assessment conducted by WSP demonstrates a sufficient reduction in key pollutants so as not to adversely impact upon water quality within the watercourse. |
| Nutrient conditions | **Surface Water Drainage**<br>There is potential for an increase in ammonia and nitrates as a result of increased road run-off entering | **Surface Water Drainage**<br>Embedded mitigation within the design of Sustainable Urban Drainage Systems (SuDS) and outfalls would ensure water quality standards are met. The HEWRAT assessment conducted by WSP demonstrates a sufficient reduction in key pollutants so as not to adversely impact upon water quality within the watercourse. |
| Specific pollutants | **Surface Water Drainage**<br>There is potential for an increase in specific pollutants as a results of increased road run-off entering the watercourse. | **Surface Water Drainage**<br>Embedded mitigation within the design of Sustainable Urban Drainage Systems (SuDS) and outfalls would ensure water quality standards are met. The HEWRAT assessment conducted by WSP demonstrates a sufficient reduction in key pollutants so as not to adversely impact upon water quality within the watercourse. |

| Quality Element | Potential Impact | Mitigation |
|---|---|---|
| **Biological Quality Elements** | | |
| Fish | **Tongwell Street Road Bridge**<br>The bridge structure would affect the composition of the aquatic habitat beneath and in the immediate vicinity of the crossing. This would principally be through the effects of shading and subsequent loss of macrophytes from the river and riparian areas in that location, and associated changes in the structure and composition of the river bed material. This could affect shelter and prey availability for fish species present. | **Tongwell Street Road Bridge**<br>The proposed backwaters and riparian enhancements would compensate for any localised changes in the aquatic habitat brought about by the construction of the clear-span bridge and consequent shading, by improving and diversifying the available habitats and ecological niches.<br>The clear-span design of the bridge will eliminate the need for structures within the channel which would affect flow. |
| | **Highway Link 107**<br>The bridge structure would affect the composition of the aquatic habitat beneath and in the immediate vicinity of the crossing. This would principally be through the effects of shading and subsequent loss of macrophytes from the river and riparian areas in that location, and associated changes in the structure and composition of the river bed material. This could affect shelter and prey availability for fish species present. | **Highway Link 107**<br>The proposed backwaters and riparian enhancements would compensate for any localised changes in the aquatic habitat brought about by the construction of the clear-span bridge and consequent shading, by improving and diversifying the available habitats and ecological niches.<br>The clear-span design of the bridge will eliminate the need for structures within the channel which would affect flow. |
| | **Moulsoe Brook Culvert Replacement**<br>Moulsoe Brook is ephemeral and is unlikely to support a resident population of fish, therefore, impacts of the structure replacement on this quality element are not likely to degrade the ephemeral stream beyond its present condition. | **Moulsoe Brook Culvert Replacement**<br>The online culvert would be designed with embedded mitigation features such as a depressed invert and a natural substrate bed. The impacts of the culverts would be offset through extensive riparian enhancement along the watercourse corridor where practicable and within the redline boundary. |

| Quality Element | Potential Impact | Mitigation |
|---|---|---|
| | **Moulsoe Brook Highway Crossing**<br>The new bridge structure would affect the composition of the aquatic habitat beneath and in the immediate vicinity of the crossing, principally through the effects of shading and subsequent loss of macrophytes from the river and riparian areas in that location, and associated changes in the structure and composition of the river bed material. This could affect shelter and prey availability for fish species present. | **Moulsoe Brook Highway Crossing**<br>Riparian habitat enhancement would be implemented elsewhere within the study reach, ideally as local to the zone of impact as possible (though there are opportunities for enhancement throughout). This would take the form of an appropriate planting regime to aid in diversifying the available habitat and ecological niches. |
| | **Surface Water Drainage**<br>There is potential for increased road run-off entering the watercourse which could result in changes to water quality and increased pollution incidents.<br>Road run-off could contain elevated levels of pollutants such as hydrocarbons, salt and/or sediment. These could reduce water quality and smother the channel bed. Fish could be directly and indirectly affected by such changes through the degradation of spawning habitat and reduced water quality or toxicity. | **Surface Water Drainage**<br>Embedded mitigation within the design of Sustainable Urban Drainage Systems (SuDS) and outfalls would ensure water quality standards are met. The HEWRAT assessment conducted by WSP demonstrates a sufficient reduction in key pollutants so as not to adversely impact upon water quality within the watercourse. |
| Aquatic macroinvertebrates | **Tongwell Street Road Bridge**<br>The bridge structure has the potential to impact on the structure of the aquatic habitat beneath and in the immediate vicinity of the crossing, principally through the effects of shading and subsequent loss of macrophytes from the river and riparian areas in that location, and associated changes in the structure and composition of the river bed material. This would affect the composition of the benthic macroinvertebrate community in this area. | **Tongwell Street Road Bridge**<br>The proposed backwaters and riparian enhancements would compensate for any localised changes in the benthic macroinvertebrate community brought about by the construction of the clear-span bridge, by improving and diversifying the available habitats and ecological niches.<br>The clear-span design of the bridge will eliminate the need for structures within the channel which would affect flow. |

| Quality Element | Potential Impact | Mitigation |
|---|---|---|
| | **Highway Link 107**<br>The bridge structure has the potential to impact on the structure of the aquatic habitat beneath and in the immediate vicinity of the crossing, principally through the effects of shading and subsequent loss of macrophytes from the river and riparian areas in that location, and associated changes in the structure and composition of the river bed material. This would affect the composition of the benthic macroinvertebrate community in this area. | **Highway Link 107**<br>The proposed backwaters and riparian enhancements would compensate for any localised changes in the benthic macroinvertebrate community brought about by the construction of the clear-span bridge, by improving and diversifying the available habitats and ecological niches.<br>The clear-span design of the bridge will eliminate the need for structures within the channel which would affect flow. |
| | **Moulsoe Brook Culvert Replacement**<br>The proposed 21m culvert replacement would continue to influence on available habitat and ecological niches within Moulsoe Brook. Impacts of the structure replacement on this quality element are not likely to affect the habitat at the water body scale or degrade the ephemeral stream beyond its present condition. | **Moulsoe Brook Culvert Replacement**<br>The impacts of the culverts would be offset through extensive riparian enhancement along the watercourse corridor where practicable and within the redline boundary. |
| | **Moulsoe Brook Highway Crossing**<br>The new bridge structure would affect the composition of the aquatic habitat beneath and in the immediate vicinity of the crossing. This would principally be through the effects of shading and subsequent loss of macrophytes from the river and riparian areas in that location, and associated changes in the structure and composition of the river bed material. This would directly affect the composition of the benthic macroinvertebrate community in this area as well as limiting habitat and prey availability. | **Moulsoe Brook Highway Crossing**<br>Riparian habitat enhancement would be implemented elsewhere within the study reach, ideally as local to the zone of impact as possible (though there are opportunities for enhancement throughout). This would take the form of an appropriate planting regime to aid in diversifying the available habitat and ecological niches. |

| Quality Element | Potential Impact | Mitigation |
|---|---|---|
| | **Surface Water Drainage**<br><br>There is potential for increased road run-off entering the watercourse which could result in changes to water quality and increased pollution incidents.<br><br>Road run-off could contain elevated levels of pollutants such as hydrocarbons, salt and/or sediment. These could reduce water quality and smother the channel bed. Aquatic macroinvertebrates could be directly and indirectly affected by such changes through smothering, reduced water quality, degradation in feeding habitat and available refugia. | **Surface Water Drainage**<br><br>Embedded mitigation within the design of Sustainable Urban Drainage Systems (SuDS) and outfalls would ensure water quality standards are met. The HEWRAT assessment conducted by WSP demonstrates a sufficient reduction in key pollutants so as not to adversely impact upon water quality within the watercourse. |

**Table 5-4 - Assessment of impact to WFD quality elements during the operation phase for the Broughton Brook**

| Quality Element | Potential Impact | Mitigation |
|---|---|---|
| **Water body ID** | GB105033037930 | |
| **Water body name** | Broughton Brook | |
| **Hydromorphological Quality Elements** | | |
| Quantity and dynamics of flow | **Highway Link 107**<br>The large road embankment would potentially cause flow to back-up in the lower reaches of Broughton Brook during flood events. | **Highway Link 107**<br>Backwater habitat creation would be implemented to offset the impacts on quantity and dynamics of flow. These features would connect during elevated flow events to create niche habitat, hydraulic variation and fish refuge. |
| | **Surface Water Drainage**<br>Increased runoff due to stripped land could lead to a detrimental change to flow dynamics and quantity. | **Surface Water Drainage**<br>Drainage would be intercepted by SuDS features such as swales and wetlands. Floodplain planting would be implemented to generate roughness and prevent rapid runoff. |
| River continuity | **Highway Link 107**<br>The large road embankment would potentially cause flow to back-up in the lower reaches of Broughton Brook during flood events. This would potentially impact on longitudinal connectivity, albeit intermittently. | **Highway Link 107**<br>Backwater habitat creation would be implemented to offset the impacts on river continuity. These features would connect during elevated flow events to create niche habitat, hydraulic variation and fish refuge. |
| River depth and width variation | **Highway Link 107**<br>The large road embankment would potentially cause flow to back-up in the lower reaches of Broughton Brook during flood events. This would potentially lead to greater width | **Highway Link 107**<br>Backwater habitat creation would be implemented to offset the impacts on river width and depth variation. These features would connect during elevated flow events to create niche habitat, hydraulic variation and fish refuge. |

| Quality Element | Potential Impact | Mitigation |
|---|---|---|
| | and depth during flood events, though these impacts would probably be intermittent. | |
| | **Surface Water Drainage**<br>Surface water drainage may provide pathways for fine material to enter the channel and gradually accumulate, leading to a detrimental impact on width and depth variation. | **Surface Water Drainage**<br>Drainage will be treated in SuDS such as swales and wetlands. Floodplain planting would be implemented to intercept fines and bind soils to avoid runoff. |
| Structure and substrate of the river bed | **Highway Link 107**<br>The impoundment of flood flow due to the proposed road embankment could lead to deposition and accumulation of fines. | **Highway Link 107**<br>The bridge abutments have been designed to be set back as far as practicable to limit flow constriction and maintain lateral connectivity. Riparian planting and the proposed backwater features would offset local impacts of the structure. |
| | **Surface Water Drainage**<br>Increased sediment runoff could smother the existing river substrate and detrimentally alter the structure and substrate of the river bed. | **Surface Water Drainage**<br>Floodplain planting would reduce sediment runoff, while SuDS features such as swales and wetlands would intercept fines. In addition, riparian planting would act as a buffer zone between the channel and its floodplain to further prevent fines from entering the watercourse. |
| Structure of the riparian zone | **Highway Link 107**<br>None anticipated. | **Highway Link 107**<br>None required. |

| Quality Element | Potential Impact | Mitigation |
|---|---|---|
| **Physico-chemical Quality Elements** | | |
| Oxygenation conditions | **Surface Water Drainage**<br>There is potential for an increase in biochemical oxygen demand as a result of increased road run-off entering the watercourse. Construction of wing-walled structures within close proximity to the channel would result in a direct loss of riparian habitat. | **Surface Water Drainage**<br>Embedded mitigation within the design of Sustainable Urban Drainage Systems (SuDS) and outfalls would ensure water quality standards are met. The HEWRAT assessment conducted by WSP demonstrates a sufficient reduction in key pollutants so as not to adversely impact upon water quality within the watercourse. Riparian enhancements would be incorporated to the planting regime described previously. |
| Acidification | **Surface Water Drainage**<br>There is potential for an increase in acidity as a result of increased road run-off entering the watercourse. However, the risk would be minimised due to the hard to very hard water of the region; meaning that the potential for acidification would be reduced by the buffering capacity of the watercourse's natural water quality. | **Surface Water Drainage**<br>Embedded mitigation within the design of Sustainable Urban Drainage Systems (SuDS) and outfalls would ensure water quality standards are met. The HEWRAT assessment conducted by WSP demonstrates a sufficient reduction in key pollutants so as not to adversely impact upon water quality within the watercourse. |
| Nutrient conditions | **Surface Water Drainage**<br>There is potential for an increase in ammonia and nitrates as a result of increased road run-off entering | **Surface Water Drainage**<br>Embedded mitigation within the design of Sustainable Urban Drainage Systems (SuDS) and outfalls would ensure water quality standards are met. The HEWRAT assessment conducted by WSP demonstrates a sufficient reduction in key pollutants so as not to adversely impact upon water quality within the watercourse. |
| Specific pollutants | **Surface Water Drainage**<br>There is potential for an increase in specific pollutants as a results of increased road run-off entering the watercourse. | **Surface Water Drainage**<br>Embedded mitigation within the design of Sustainable Urban Drainage Systems (SuDS) and outfalls would ensure |

| Quality Element | Potential Impact | Mitigation |
|---|---|---|
| | | water quality standards are met. The HEWRAT assessment conducted by WSP demonstrates a sufficient reduction in key pollutants so as not to adversely impact upon water quality within the watercourse. |
| **Biological Quality Elements** | | |
| Aquatic macroinvertebrates | **Highway Link 107**<br>The road embankment has the potential to increase back flow into Broughton Brook during flood events. This has the potential for increased sediment deposition which could smother aquatic macroinvertebrates directly, in addition to smother available habitat and food sources. The structure and composition of bed material could be altered if back flow occurs regularly. | **Highway Link 107**<br>The proposed backwaters and riparian enhancements would compensate for any localised changes in the benthic macroinvertebrate community by improving and diversifying the available habitats and ecological niches as well as connectivity during elevated flow events. |
| | **Surface Water Drainage**<br>There is potential for increased road run-off entering the watercourse which could result in changes to water quality and increased pollution incidents.<br>Road run-off could contain elevated levels of pollutants such as hydrocarbons, salt and/or sediment. These could reduce water quality and smother the channel bed. Aquatic macroinvertebrates could be directly and indirectly affected by such changes through smothering, reduced water quality, degradation in feeding habitat and available refugia. | **Surface Water Drainage**<br>Embedded mitigation within the design of Sustainable Urban Drainage Systems (SuDS) and outfalls would ensure water quality standards are met. The HEWRAT assessment conducted by WSP demonstrates a sufficient reduction in key pollutants so as not to adversely impact upon water quality within the watercourse. |
| Aquatic flora (macrophytes) | **Highway Link 107**<br>The road embankment has the potential to increase back flow into Broughton Brook during flood events. This has the potential for increased sediment deposition which could smother macrophytes directly. The structure and | **Highway Link 107**<br>The proposed backwaters and riparian enhancements would compensate for any localised changes in the macrophyte composition by improving and diversifying the |

| Quality Element | Potential Impact | Mitigation |
|---|---|---|
| | composition of bed material could be altered if back flow occurs regularly changing the availability for macrophyte colonisation. | habitat and ecological niches as well as connectivity during elevated flow events. |
| | **Surface Water Drainage**<br>There is potential for increased road run-off entering the watercourse which could result in changes to water quality and increased pollution incidents.<br>Road run-off could contain elevated levels of pollutants such as hydrocarbons, salt and/or sediment. These could reduce water quality and smother the channel bed. Macrophytes could be directly and indirectly affected by such changes through smothering and reduced water quality. | **Surface Water Drainage**<br>Embedded mitigation within the design of Sustainable Urban Drainage Systems (SuDS) and outfalls would ensure water quality standards are met. The HEWRAT assessment conducted by WSP demonstrates a sufficient reduction in key pollutants so as not to adversely impact upon water quality within the watercourse. |

## 5.3 STEP 3: ASSESSMENT OF THE SCHEME AGAINST WFD OBJECTIVES

5.3.1. The compliance of the Scheme would be determined based upon an assessment against the following objectives relating to the biological, physico-chemical and hydromorphological quality elements:

- Does the Scheme cause deterioration in the Ecological Potential or Status of a body of surface or ground water?
- Does the Scheme compromise the ability of the water body to achieve *Good* Ecological Status or Potential?
- Does the Scheme cause a permanent exclusion or compromise achievement of the WFD objectives (e.g. mitigation measures) in other water bodies within the same RBD?
- Does the Scheme contribute to the delivery of the WFD objectives (e.g. mitigation measures)?

5.3.2. The WFD compliance assessment for the Scheme is summarised Table 5-5.

**Table 5-5 - WFD compliance assessment for water bodies scoped into this WFDa**

| **Water body ID** | **GB105033037971** | **GB105033037972** | **GB105033037930** |
|---|---|---|---|
| **Water body name** | **Ouzel Us Caldecote Mill** | **Ouzel DS Caldecote Mill** | **Broughton Brook** |
| Deterioration in the status/potential of the water body | **Biological:**<br>It is not envisaged that the Scheme would cause a deterioration in the status/potential of the water body for biological elements.<br>**Physico-chemical:**<br>It is not envisaged that the Scheme would cause deterioration in the status/potential of the water body for the physico-chemical quality elements due to the proposed embedded mitigation.<br>**Hydromorphological:**<br>With mitigation in place, the Scheme is unlikely to cause deterioration of the current hydromorphological status of the water body. | | |
| Ability of the water body to achieve *Good* Ecological Potential/Status | The Scheme and proposed mitigation would not prevent the implementation of WFD mitigation measures towards the water body's objectives. | | |
| Impact on the WFD objectives of other water bodies within the same RBD | No downstream or upstream impacts are anticipated associated with the preferred option and the mitigation measures proposed. | | |
| Ability to contribute to the delivery of the WFD objectives | Yes. | Yes. | Yes. |

## 5.4 STEP 4: ASSESSMENT OF THE SCHEME AGAINST OTHER EU LEGISLATION

5.4.1. Article 4.9 of the WFD requires that “Member States shall ensure that the application of the new provisions guarantees at least the same level of protection as the existing Community legislation”.

5.4.2. The Nitrates Directive is relevant to the assessment of new modifications. Any potential change in the nutrient dynamics due to the Scheme is most likely due to changes in the sediment regime. No sources of nitrates would be introduced to the water body as part of the Scheme. Any pollutants sourced from highway drainage would be controlled and treated through the proposed drainage system. Therefore, no separate assessment is required for nitrates.

5.4.3. The Freshwater Fish Directive was originally adopted in 1978 and was consolidated in 2006, then repealed in 2013. Therefore, no separate assessment is required for fish and the Scheme would be designed to mitigate impacts on fish.

# 6 CONSTRUCTION IMPACTS

6.1.1. The WFD Assessment does not require assessment of potential construction impacts on a water body. This is because the impacts are temporary and do not permanently affect the water body. However, construction impacts on fluvial geomorphology are considered in this section due to the potential impacts of the construction activities of the Scheme on the water bodies.

6.1.2. Furthermore, following consultation with the EA on 19 January 2021, the EA geomorphologist stated that any construction impacts of no more than three months may be considered temporary, and any construction impacts of longer duration should be considered as permanent.

6.1.3. For the assessment of construction impacts, fluvial geomorphology has been separated into three elements, the sediment regime, channel morphology and fluvial processes. An ecology element is also included to outline potential impacts on habitats and species. Table 6-1 outlines the potential impacts on these four elements during the construction of the Scheme. The main potential impacts relate to an increase in fine sediment delivery, localised reduction in morphological diversity, a change in natural fluvial processes and degradation of downstream water quality and potential smothering of habitats.

6.1.4. In addition, weather conditions would also influence the severity of impacts. Many of these impacts would worsen with intense or prolonged rainfall events during the construction phase. However, by adopting the robust methods outlined in the CEMP, these impacts should be reduced to have negligible impact.

**Table 6-1 - Potential construction impacts on the water bodies**

| Source of Impact | Potential Impacts and Mitigation |
|---|---|
| **Suspended Solids**<br>Increased fine sediment supply to watercourses is likely to occur for discrete periods during construction works. This could result from:<br>▪ Runoff from vegetation-free surfaces;<br>▪ Plant and vehicle washing;<br>▪ Earthworks within or adjacent to the watercourses; and,<br>▪ Vegetation clearance. | **Sediment regime**<br>Construction impacts could include fine sediment release, which may cause detrimental impact. The risk of this occurring should be minimal if best practice and pollution prevention guidelines are followed. Potential impacts include changes to the water quality due to sediment release and smothering of ecological habitats. Measures outlined in the CEMP are deemed suitable to minimise the risk of these potential impacts from occurring.<br>**Channel morphology**<br>No significant impact.<br>**Natural fluvial processes**<br>The construction of online structures would involve temporary blocking or constriction of watercourses with pumping of flows to downstream of the works area. This would only have a temporary impact on the fluvial processes and therefore not expected to impact WFD water body status.<br>**Ecology**<br>There is potential for sediment pollution during the construction phase through surface water run-off from the site; and also through chemicals, fuels and construction materials used during construction. This could cause degradation of habitat, food sources, water quality or cause direct |

| Source of Impact | Potential Impacts and Mitigation |
|---|---|
| | mortality of fish and macroinvertebrates. Embedded pollution prevention measures will reduce the risk of serious pollution to negligible levels. |
| **Vegetation clearance**<br>Vegetation clearance during construction could reduce the stability of the river channels, increasing the potential for erosion and associated sediment release. Sediment release is likely to be greatest where vegetation clearance is required on slopes and would be particularly significant where tress clearance is required. | **Sediment regime**<br>Potential impacts include changes to the water quality due to sediment release and smothering of ecological habitats. Potential impacts on the sediment regime due to fine sediment release during vegetation clearance should be minimised by following best practice and pollution prevention guidance for working in water bodies. A CEMP will be prepared prior to construction and will include measures that are suitable to minimise the risk of these potential impacts from occurring.<br>**Channel morphology**<br>Vegetation removal would be required for the construction of the Scheme. Therefore, construction impacts may cause destabilisation of existing morphological features. Measures that will be outlined in the CEMP will be suitable to minimise the risk of these potential impacts from occurring.<br>**Natural fluvial processes**<br>No significant impact.<br>**Ecology**<br>Fine sediment release could choke sediments utilised by aquatic organisms (invertebrates, fish etc.). Increased suspended sediment load could adversely impact fish by reducing visibility, therefore impacting upon feeding habits. In addition, suspended sediment can irritate the gills of adult fish, and lead to mortality in younger fish. Potential impacts would be minimised by following best practice and pollution prevention guidance for working in water bodies. |
| **Piling activities** | **Ecology**<br>There is potential for construction activities such as piling to create noise and vibration which might lead to delay or disruption of fish behaviour and migration. The selection of piling methods which reduce noise and vibration is recommended, in addition to the avoidance of key migration periods for fish. This reduces the risk of any significant effects on fish. |
| **Site compound areas** | **Sediment regime**<br>Construction impacts could include sediment release, which may cause detrimental impact. Potential impacts include changes to the water quality due to sediment release and smothering of ecological habitats. The risk of this occurring should be minimal if best practice and pollution prevention guidelines are followed. Measures that will be outlined in the CEMP are deemed suitable to minimise the risk of these potential impacts from occurring<br>**Channel morphology**<br>No significant impact.<br>**Natural fluvial processes**<br>No significant impact.<br>**Ecology**<br>Construction impacts could include substance releases, which may cause a detrimental impact on aquatic ecology. Potential impacts include changes to the water quality due the substance release and smothering of ecological habitats and macrophytes. The risk of this occurring should be minimal if best practice and pollution prevention guidelines are followed. Additionally, mitigation measures for specific ecological risks, |

| Source of Impact | Potential Impacts and Mitigation |
|---|---|
| | such as fish species, should be adhered to and would be detailed in the CEMP.<br>**Water quality**<br>Construction impacts could include contaminant release from substances such as fuel or concrete during the construction period, especially for Highway Link 107 and activities in and around the site compound area. This could detrimentally impact the water quality and ecology downstream. Cement pollution could increase the pH and alkalinity in the water body, affecting aquatic life. The risk of this occurring should be minimal if best practice and pollution prevention guidelines are followed. Measures that will be outlined in the CEMP are deemed suitable to minimise the risk of these potential impacts from occurring. |
| **All earthworks have the potential to short-circuit hydrogeological pathways, heighten groundwater vulnerability and introduce or mobilise contaminants. Deep earthworks may also entail dewatering (such as cuttings) and other works such as piling may also generate/propagate turbidity.** | Most aspect of groundworks construction would be suitably mitigated by the development of a CEMP. |

# 7 CONCLUSION

7.1.1. This WFD assessment has considered the potential impacts of the Scheme on the water bodies monitored as part of the Water Framework Directive. Three surface water bodies have been scoped into this WFD assessment, as follows:

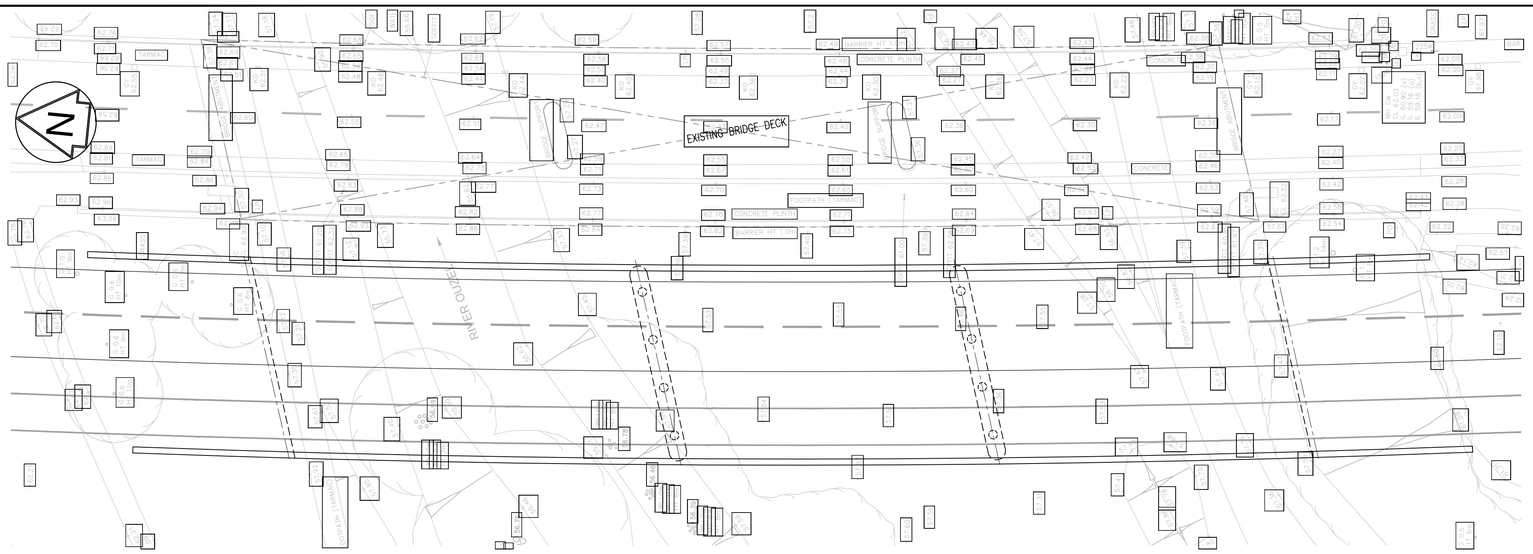
- Ouzel US Caldecote Mill (Moderate status);
- Ouzel DS Caldecote Mill (Moderate status); and
- Broughton Brook (Poor status).

7.1.2. The assessment has demonstrated that the activities associated with the Scheme without appropriate mitigation has the potential to adversely impact upon a number of WFD quality element receptors and thus could either influence the status of the WFD water bodies, contribute to a deterioration in its status or impede achievement of WFD objectives.

7.1.3. The assessment demonstrates that appropriate mitigation is and can be included within the Scheme to neutralise the likely impacts and removing the risk of a deterioration in status of any of the designated bodies. As such the Scheme is deemed to be compliant with the Water Framework Directive.

# Appendix A

## DESIGN DRAWINGS




PLAN
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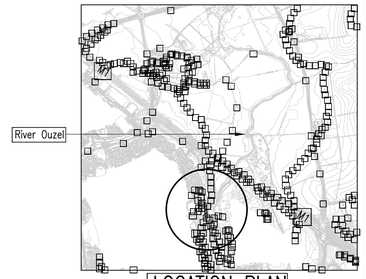


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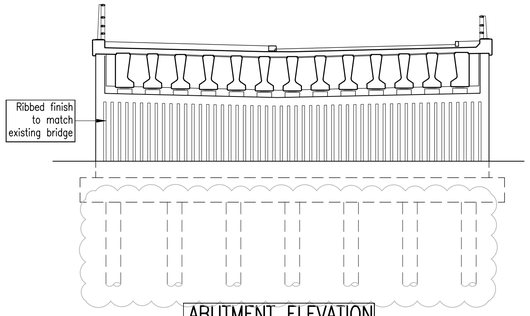
1:25000




ABUTMENT ELEVATION
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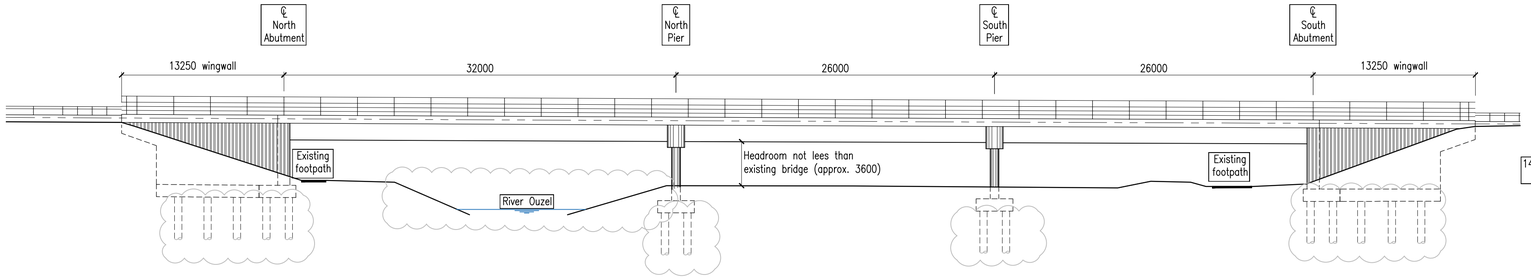


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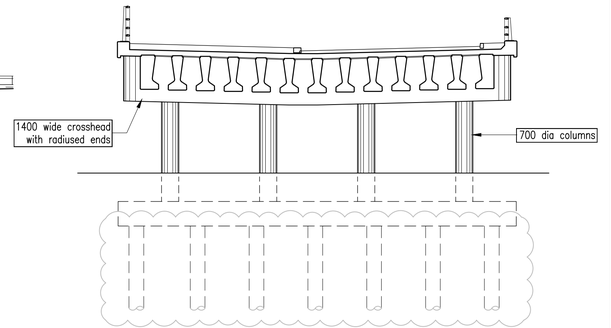
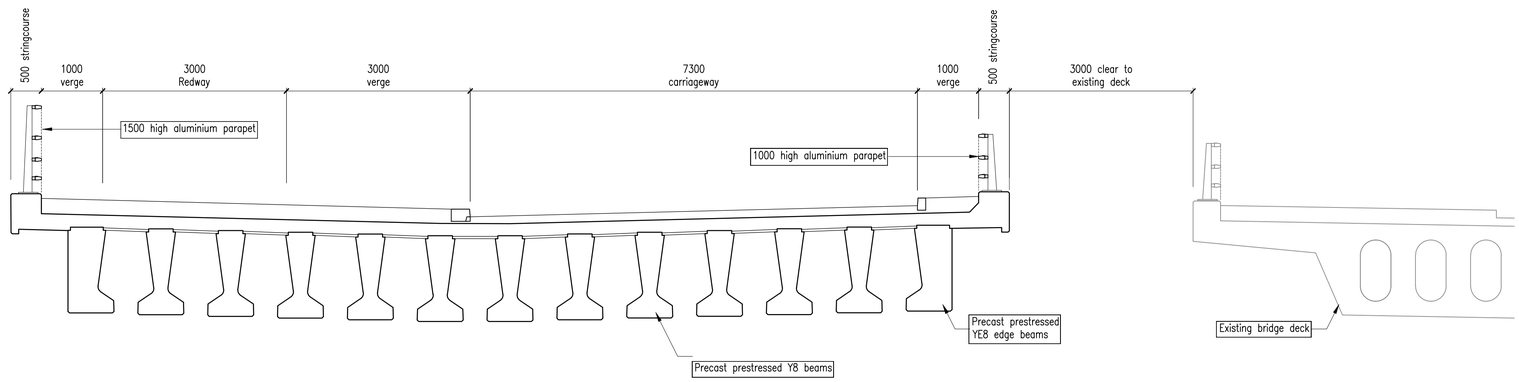
1:250




PIER ELEVATION
1:125




DECK CROSS SECTION
1:50

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| REV | DATE | BY | DESCRIPTION | CHK | APD |
|---|---|---|---|---|---|
| P03 | 16/11/20 | CPW | WEST ELEVATION: RIVER OUZEL PROFILE NOW SHOWN AT W PIER LOCATION. PILES ADDED. | JSCS | JSCS |
| P02 | 28/10/20 | CPW | DECK LEVEL RAISED 0.2m. PLUS REVISIONS AS CLOUDED. | JSCS | JSCS |
| P01 | 14/10/20 | CPW | INITIAL ISSUE | JSCS | JSCS |

DRAWING STATUS: S2-FOR INFORMATION


wsp
Mountbatten House, Basing View, Basingstoke, RG21 4HJ, UK
T+ 44 (0) 1256 318 800, F+ 44 (0) 1256 318 700
wsp.com


CLIENT: BERKELEY STRATEGIC

ARCHITECT:

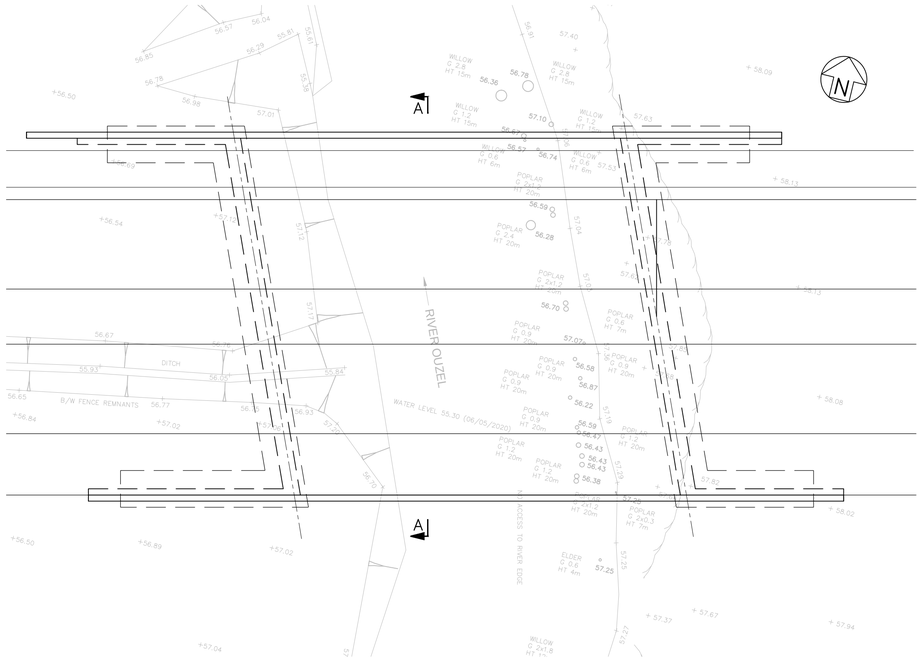
SITE/PROJECT: MILTON KEYNES EAST

TITLE: TONGWELL STREET NORTHBOUND BRIDGE

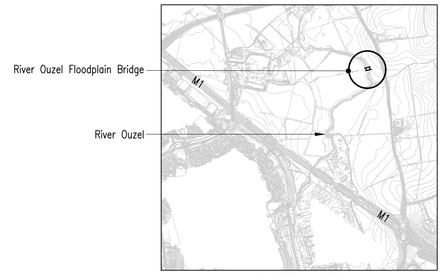
| SCALE @ A1: | CHECKED: | APPROVED: |
|---|---|---|
| AS SHOWN | JSCS | PD |

| PROJECT No: | DESIGN: | DRAWN: | DATE: |
|---|---|---|---|
| 70014859 | JSCS | CPW | September 20 |

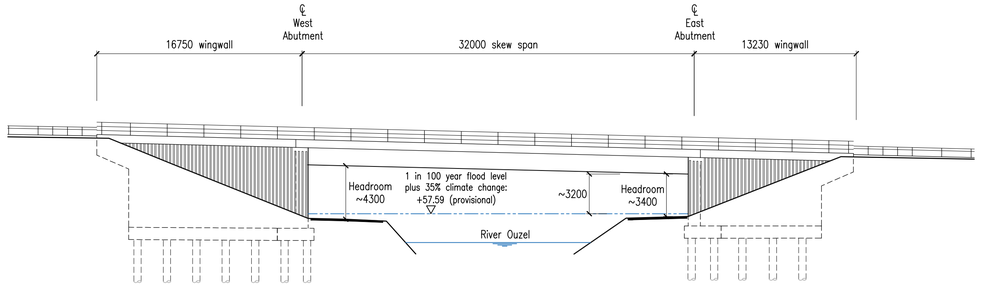
DRAWING No: 1078-WSP-CBR-TSN-DR-BR-001 REV: P03




PLAN
1:250




LOCATION PLAN
1:25000




SOUTH ELEVATION
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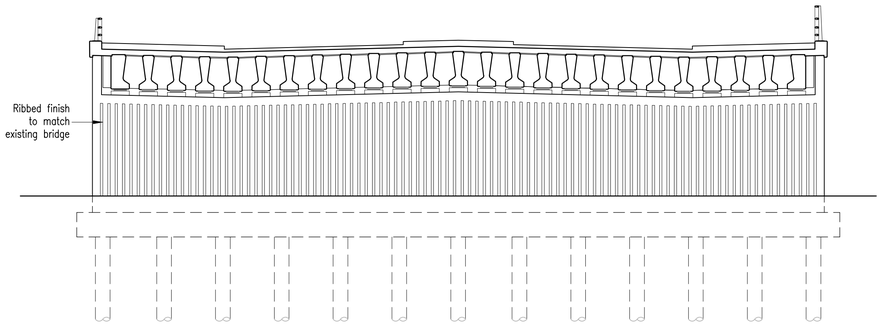
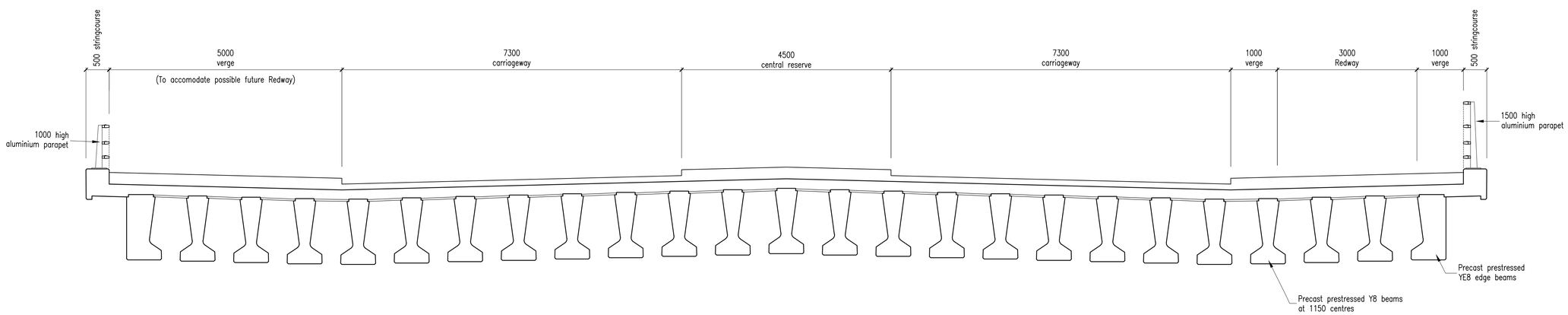



WEST ABUTMENT ELEVATION
1:125




SECTION A–A
1:50

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|---|---|---|---|---|---|
| P01 | 02/11/20 | CPW | INITIAL ISSUE | JSCS | JSCS |

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T+ 44 (0) 1256 318 800, F+ 44 (0) 1256 318 700
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ARCHITECT:

SITE/PROJECT: MILTON KEYNES EAST

TITLE: RIVER OUZEL FLOODPLAIN BRIDGE

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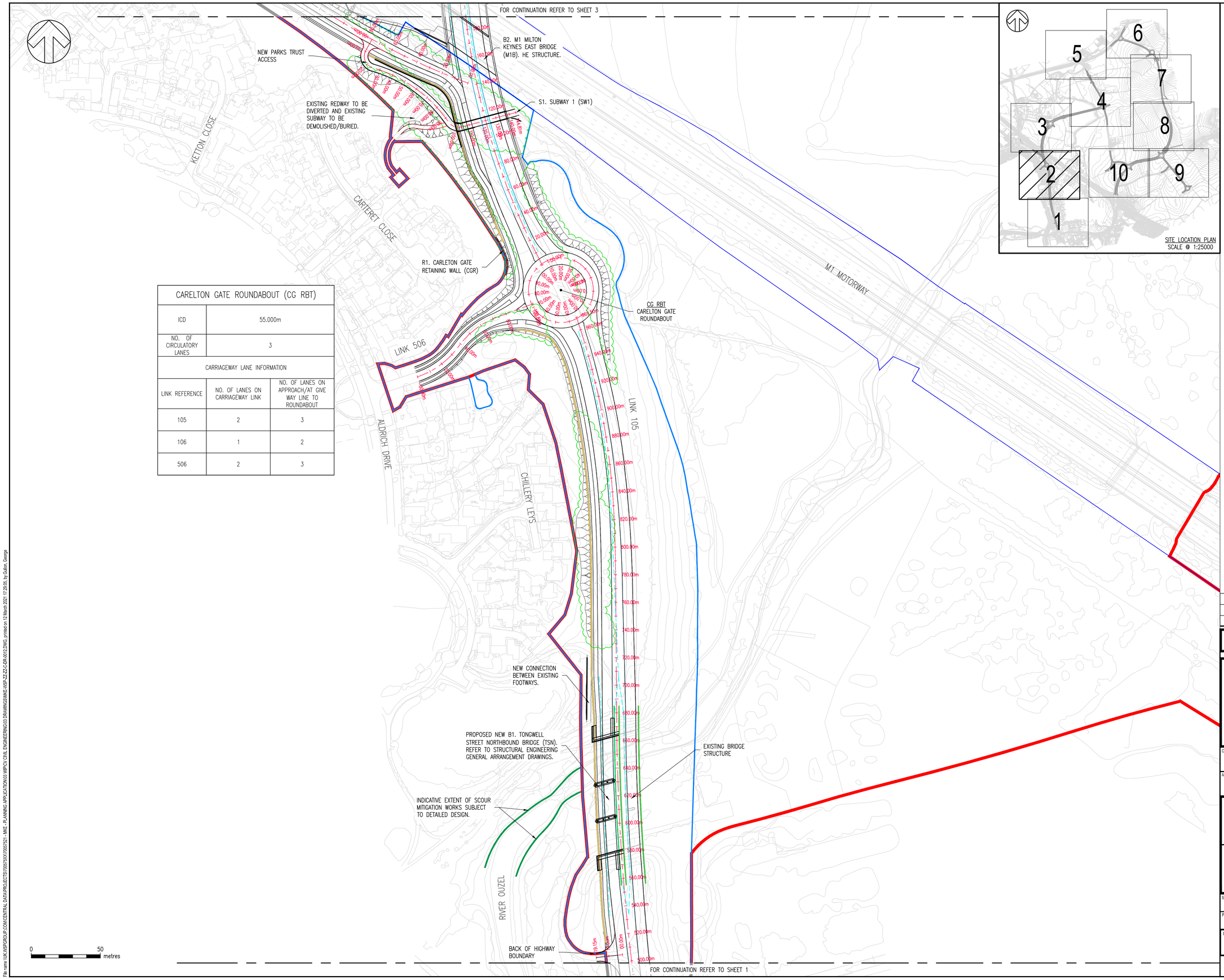
|---|---|---|
| AS SHOWN | JSCS | PD |

| PROJECT No: | DESIGN: | DRAWN: | DATE: |
|---|---|---|---|
| 70014859 | JSCS | CPW | November 20 |

DRAWING No: 1078-WSP-CBR-ROF-DR-BR-001 REV: P01




| CARELTON GATE ROUNDABOUT (CG RBT) | | |
|---|---|---|
| ICD | 55.000m | |
| NO. OF CIRCULATORY LANES | 3 | |
| CARRIAGEWAY LANE INFORMATION | | |
| LINK REFERENCE | NO. OF LANES ON CARRIAGEWAY LINK | NO. OF LANES ON APPROACH/AT GIVE WAY LINE TO ROUNDABOUT |
| 105 | 2 | 3 |
| 106 | 1 | 2 |
| 506 | 2 | 3 |



SITE LOCATION PLAN
SCALE @ 1:25000

## DO NOT SCALE

NOTES:

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8. THE MILTON KEYNES HIGHWAY BOUNDARY IS TAKEN FROM INTERACTIVE HIGHWAY BOUNDARY MAPPING FOUND ON THE MILTON KEYNES COUNCIL'S WEBSITE.
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KEY:

GENERAL

- OUTLINE PLANNING APPLICATION BOUNDARY
- HIGHWAYS ENGLAND HIGHWAY BOUNDARY
- MILTON KEYNES COUNCIL HIGHWAY BOUNDARY
- PROPOSED TRANSPORTATION CORRIDOR
- LAND SAFEGUARDED FOR FUTURE TRANSPORTATION CORRIDOR
- PROPOSED NOISE FENCE
- EXISTING TREES AND VEGETATION WITHIN EXISTING HIGHWAY BOUNDARY IMPACTED BY THE PROPOSED WORKS (OTHER EXISTING TREES OUTSIDE THE EXISTING HIGHWAY BOUNDARY MAY BE AFFECTED AND FORM OF NOISE BARRIER TO BE DETERMINED DURING DETAILED DESIGN)
- PROPOSED VEHICLE RESTRAINT SYSTEM (VRS)

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| REV | DATE | BY | DESCRIPTION | CHK | APP |
|---|---|---|---|---|---|
| P02 | 12/03/2021 | GLG | ISSUED FOR PLANNING | ARP | SAP |
| P01 | 15/01/2021 | OPL | FIRST ISSUE | ARP | SAP |

DRAWING STATUS: S4 - FOR APPROVAL


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SITE/PROJECT: MILTON KEYNES EAST

TITLE: GENERAL ARRANGEMENT FOR PLANNING SHEET 2

| SCALE @ A1: | CHECKED: | | APPROVED: |
|---|---|---|---|
| 1:1250 | ARP | | SAP |
| PROJECT NO: | DESIGNED: | DRAWN: | DATE: |
| 70057521 | ARP | GLG | January 21 |

DRAWING No: MKE-WSP-ZZ-ZZ-C-DR-0012 REV: P02

FOR CONTINUATION REFER TO SHEET 5

EXACT LOCATION OF BUS STOP LOCATIONS TO BE AGREED BY THE LOCAL AUTHORITY.

LINK 511

LINK 108

S7. SUBWAY 7 (SW7).

A509 RBT 1
A509
ROUNDABOUT 1

LINK 509

INDICATIVE EXTENT OF SCOUR MITIGATION WORKS SUBJECT TO DETAILED DESIGN.

RIVER OUZEL

LINK 107

B3. RIVER OUZEL
FLOODPLAIN BRIDGE (ROF).
ALSO SERVES AS A
PEDESTRIAN/CYCLE SUBWAY.

C2. FLOOD RELIEF
CULVERT 2 (FR2) WITH
PEDESTRIAN/CYCLE
ACCESS.

C3. CULVERT 3
EXISTING CULVERT TO
BE LENGTHENED.

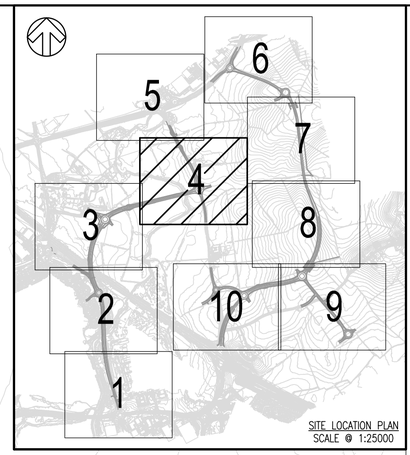
LINK 510

RIVER OUZEL

FOR CONTINUATION REFER TO SHEET 3

0 50 metres

| A509 ROUNDABOUT 1 (A509 RBT 1) | | |
|---|---|---|
| ICD | 65.000m | |
| NO. OF CIRCULATORY LANES | 3 | |
| CARRIAGEWAY LANE INFORMATION | | |
| LINK REFERENCE | NO. OF LANES ON CARRIAGEWAY LINK | NO. OF LANES ON APPROACH/AT GIVE WAY LINE TO ROUNDABOUT |
| 107 | 2 | 3 |
| 108 | 1 | 3 |
| 509 | 1 | 3 |
| 510 | 1 | 3 |




SITE LOCATION PLAN
SCALE @ 1:25000

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9. TOPOGRAPHICAL INFORMATION PROVIDED BY MK SURVEYS FILE – "28562" ON THE 11/06/2020 AND 3D ENGINEERING SURVEYS FILE – "DES21007_MKE_REV1" ON THE 22/02/2021. WSP CAN NOT ACCEPT RESPONSIBILITY FOR ANY INACCURACIES.
10. ALL REDWAYS DESIGNED IN ACCORDANCE WITH LTN 2/08.
11. EARTHWORKS SHOWN OUTSIDE THE TRANSPORTATION CORRIDOR SHALL BE REVIEWED DURING DETAILED DESIGN STAGE WITH A VIEW TO EITHER LOCALLY STEEPEN OR ADJUSTING EXISTING GROUND LEVELS SO THAT ALL WORKS ARE LOCATED WITHIN THE CORRIDOR.

KEY:

GENERAL

- OUTLINE PLANNING APPLICATION BOUNDARY
- HIGHWAYS ENGLAND HIGHWAY BOUNDARY
- MILTON KEYNES COUNCIL HIGHWAY BOUNDARY
- PROPOSED TRANSPORTATION CORRIDOR
- LAND SAFEGUARDED FOR FUTURE TRANSPORTATION CORRIDOR
- PROPOSED NOISE FENCE
- EXISTING TREES AND VEGETATION WITHIN EXISTING HIGHWAY BOUNDARY IMPACTED BY THE PROPOSED WORKS (OTHER EXISTING TREES OUTSIDE THE EXISTING HIGHWAY BOUNDARY MAY BE AFFECTED AND FORM OF NOISE BARRIER TO BE DETERMINED DURING DETAILED DESIGN)
- PROPOSED VEHICLE RESTRAINT SYSTEM (VRS)

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| REV | DATE | BY | DESCRIPTION | CHK | APP |
|---|---|---|---|---|---|
| P02 | 12/03/2021 | GLG | ISSUED FOR PLANNING | ARP | SAP |
| P01 | 15/01/2021 | OPL | FIRST ISSUE | ARP | SAP |

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SITE/PROJECT: MILTON KEYNES EAST

TITLE: GENERAL ARRANGEMENT FOR PLANNING SHEET 4

| SCALE @ A1: | CHECKED: | APPROVED: |
|---|---|---|
| 1:1250 | ARP | SAP |

| PROJECT NO: | DESIGNED: | DRAWN: | DATE: |
|---|---|---|---|
| 70057521 | ARP | GLG | March 21 |

DRAWING No: MKE-WSP-ZZ-ZZ-C-DR-0014 REV: P02



File name: UK:\WSPGROUP.COM\CENTRAL DATA\PROJECTS\70057500\03 WIP\CV CIVIL ENGINEERING\03 DRAWINGS\MKE-WSP-ZZ-ZZ-C-DR-0014.DWG, printed on 12 March 2021 17:32:56, by Gullen, George

# Appendix B

## MINUTES OF TELECONFERENCE WITH THE EA

# AGENDA & MEETING NOTES

| | | | |
|---|---|---|---|
| **PROJECT NUMBER** | 70057521 | **MEETING DATE** | 19 January 2021 |
| **PROJECT NAME** | Milton Keynes East | **VENUE** | Teleconference |
| **CLIENT** | St James Group | **RECORDED BY** | FM |
| **MEETING SUBJECT** | WFD Scoping and Screening consultation | | |

| | |
|---|---|
| **PRESENT** | WSP: Andy Smith (AS), Helena Parsons (HP), Frances Marlow (FM), Aidan Wilks-Daly (AWD)<br>EA: Ellis Selway (ES) |
| **DISTRIBUTION** | As above plus: Simon Purcell, Adrian Meurer, Claire Hands, Mike Hill, Nick Trollope, Ashley Spearing |
| **CONFIDENTIALITY** | **Confidential** |

| ITEM | SUBJECT | ACTION | DUE |
|---|---|---|---|
| **1** | **Introduction** | | |
| **1.1** | AS provided overview of the Proposed Scheme including<br><br>Site location<br>Planning boundary<br>Overview of watercourse network<br>Site masterplan and phased building<br>Explanation of hybrid planning application elements<br>Specific details of Tongwell Street Road Bridge and Highway Link 107<br>Results of flood modelling | | |
| **1.2** | HP asked for confirmation over whether the WFDa would require the inclusion of the outline planning application elements, or if these could be left to a later stage. | | |
| **1.3** | ES needed to confirm with colleagues at the EA, however it is anticipated that it would be appropriate to screen in all WFD water bodies for both outline and full planning elements, however a compliance assessment can only be carried out for the elements in the full planning application. A compliance assessment for the elements in the outline planning application would need to be conditioned through the planning response. | ES | |
| **2** | **Screening of WFD water bodies** | | |
| **2.1** | FM presented the six waterbodies in the vicinity of the Proposed Scheme:<br><br>Broughton Brook *(Screened in)*<br>River Ouzel US Caldecote Mill *(Screened in)* | | |

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|---|---|---|---|
| | River Ouzel DS Caldecote Mill *(Screened in)*<br>River Great Ouse (Wolverton to Newport Pagnell) *(Screened out)*<br>River Great Ouse (Newport Pagnell to Roxton) *(Screened in)*<br>Upper Bedford Ouse Principal Oolite 2 Groundwater body *(Screened out)* | | |
| **2.2** | ES agreed with the screening conclusions and added that the River Great Ouse (NP to R) could also be screened out due to its distance downstream and effects of Proposed Scheme unlikely to reach this waterbody. | | |
| **3** | **Screening of activities** | | |
| **3.1** | FM presented the activities within the detailed planning application which would be screened into the WFD assessment:<br>Tongwell Street Road Bridge (Screened in)<br>Highway Link 107 and River Ouzel crossing (Screened in)<br>Moulsoe Brook Culvert (Screened in)<br>Moulsoe Brook highway crossing (Screened in)<br>Surface water drainage (Screened in)<br>Attenuation ponds (Screened out) | | |
| **3.2** | ES agreed with the screened activities. ES added that the following would also need to be included:<br>Construction phase activities. Often split into temporary and permanent works where temporary works are part of the construction phase and up to 3 months into the operational phase, and permanent works being in the operational phase.<br>Any channel modifications/diversions/realignment<br>The proposed bank protection downstream of the River Ouzel crossing for the Viking camp remains<br>Any elements that may limit reconnection with historic watercourses<br>Any elements that may prevent completion of planned WFD measures for the waterbodies. (ES to send through a list of WFD measures for waterbodies identified in screening process) | ES | |
| **4** | **Scoping of WFD quality elements** | | |
| **4.1** | FM presented the scoping of quality elements for the activities screened into the assessment. ES generally agreed with conclusions however will check through and confirm post-meeting.<br>*(See table below of scoped quality elements)*<br>ES confirmed that would only need to considered quality elements that have been monitored in the cycle 2 data. *(Elements no longer included in monitoring have been crossed out in table below)* | ES | |
| **5** | **WFDa methodology** | | |
| **6** | FM explained the proposed methodology for the assessment: | | |

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|---|---|---|---|
| | Qualitative assessment based on readily available data for the site. Some ecological surveys have already been completed. Hydraulic modelling has already been completed.<br>It is anticipated that a walkover survey for ecology and geomorphology is completed however this would not involve collection of quantitative data (no sediment sampling or aquatic sampling).<br>FM highlighted that the site visit may not be possible due to current Covid-19 restrictions. | | |
| **6.1** | ES confirmed he was happy with this approach as it is unlikely the proposed scheme would cause direct impact to elements which would require quantitative survey | | |
| **7** | **WFD mitigation opportunities** | | |
| **7.1** | FM presented the plans for a linear park along the river corridor of the River Ouzel and that which would provide opportunity for any WFD mitigation required. | | |
| **7.2** | ES highlighted that the EA would like to see how the development can contribute to WFD measures for waterbodies and the biodiversity targets.<br>AP confirmed that the linear park element of the scheme is likely to contribute to these aims.<br>ES to provide the WFD mitigation measures for the water bodies being assessed. | | |

**NEXT MEETING**

No further meetings required prior to submission of the planning application. ES to confirm resolution of actions via email.

| WFD quality element | Tongwell Street Road Bridge | Highway Link 107 | Moulsoe Brook Culvert Replacement | Moulsoe Brook Highway Crossing | Surface Water Drainage |
|---|---|---|---|---|---|
| Quantity and Dynamics of Flow | Out | In | In | Out | In |
| Connections to Groundwaters | Out | Out | Out | Out | Out |
| River Continuity | Out | In | In | Out | Out |
| River Depth and Width Variation | In | In | In | In | In |
| Structure and Substrate of the River Bed | In | In | In | In | In |
| Structure of the Riparian Zone | In | In | In | In | Out |
| Fish | In | In | In | In | In |
| Invertebrates | In | In | In | In | In |
| Macrophytes and Phytoplankton (Broughton Brook only) | ~~In~~ | ~~In~~ | ~~In~~ | ~~In~~ | ~~In~~ |
| ~~Thermal Conditions~~ | ~~Out~~ | ~~Out~~ | ~~Out~~ | ~~Out~~ | ~~Out~~ |
| Oxygenation Conditions | Out | Out | Out | Out | In |
| ~~Salinity~~ | ~~Out~~ | ~~Out~~ | ~~Out~~ | ~~Out~~ | ~~In~~ |
| Acidification | Out | Out | Out | Out | In |
| Nutrient Conditions | Out | Out | Out | Out | In |
| Specific Pollutants | Out | Out | Out | Out | In |
| Priority Substances and Priority Hazardous Substances | Out | Out | Out | Out | In |

# Appendix C

## WFD WATER BODIES BASELINE DATA

**Table C-1 - WFD status of the Broughton Brook (GB105033037930) water body potentially impacted by the Scheme**

| Water Body ID | GB105033037930 |
|---|---|
| Water Body Name | Broughton Brook |
| Water Body Type | River |
| Water Body Area | 68.389 $km^2$ |
| Hydromorphological Designation | heavily modified |
| Overall Ecological Status | Poor |
| Current Overall Status | Poor |
| Status Objective (overall) | Good by 2027 |
| Justification | Disproportionate burdens<br>Cause of adverse impact unknown<br>Ecological recovery time |
| **Biological Quality Elements** | |
| Overall Biological Quality Element Status Objective | Moderate by 2027 (due to disproportionate burdens; no known technical solution is available; cause of adverse impact unknown) |
| Invertebrates | Poor |
| Macrophytes | Poor |
| **Physico-chemical Quality Elements** | |
| Acid Neutralising Capacity | High |
| Ammonia (Phys-Chem) | High |
| Dissolved Oxygen | High |
| Biochemical Oxygen Demand (BOD) | Good |
| pH | High |
| Phosphate | Moderate |
| Temperature | High |
| Overall Physico-Chemical Quality Element Status Objective | Good by 2027 (Cause of adverse impact unknown) |
| Specific Pollutants | High |

| Water Body ID | GB105033037930 |
|---|---|
| Triclosan | - |
| Manganese | High |
| Copper | High |
| Iron | High |
| Zinc | High |
| **Chemical** | |
| Overall Chemical Status | Fail |
| Priority Substances | Good |
| Cypermethrin (Priority hazardous) | Good |
| Fluoranthene | Good |
| Lead and Its Compounds | Good |
| Priority Hazardous Substances | Good |
| Nickel and Its Compounds | Good |
| Priority hazardous substances | Fail |
| Polybrominated diphenyl ethers (PBDE) | Fail |
| Perfluorooctane sulphonate (PFOS) | Good |
| Benzo(a)pyrene | Good |
| Cadmium and Its Compounds | Good |
| Dioxins and dioxin-like compounds | Good |
| Heptachlor and cis-Heptachlor epoxide | Good |
| Hexabromocyclododecane (HBCDD) | Good |
| Hexachlorobenzene | Good |
| Hexachlorobutadiene | Good |
| Mercury and Its Compounds | Good |
| **Hydromorphological Quality Elements** | |
| Hydromorphology Supporting Elements Status | Supports Good |
| Hydrological Regime | Supports Good |

**Table C-2 - WFD status of the Ouzel US Caldecote Mill (GB105033037971) water body potentially impacted by the Scheme**

| Water Body ID | GB105033037971 |
|---|---|
| Water Body Name | Ouzel US Caldecote Mill |
| Water Body Type | River |
| Water Body Area | 91.809 $km^2$ |
| Hydromorphological Designation | heavily modified |
| Overall Ecological Status | Moderate |
| Current Overall Status | Moderate |
| Status Objective (overall) | Moderate by 2015 |
| Justification | Unfavourable balance of costs and benefits<br>Disproportionate burdens<br>No known technical solution is available |
| **Biological Quality Elements** | |
| Overall Biological Quality Element Status Objective | Moderate by 2027 (due to disproportionate burdens; no known technical solution is available; cause of adverse impact unknown) |
| Invertebrates | Good |
| Fish | High |
| **Physico-chemical Quality Elements** | |
| Ammonia (Phys-Chem) | High |
| Dissolved Oxygen | High |
| Biochemical Oxygen Demand (BOD) | High |
| pH | High |
| Phosphate | Poor |
| Temperature | High |
| Overall Physico-Chemical Quality Element Status Objective | Moderate by 2015 (No known technical solution is available) |
| Specific Pollutants | High |
| Triclosan | - |
| Manganese | High |

| Water Body ID | GB105033037971 |
|---|---|
| Copper | - |
| Iron | High |
| Zinc | - |
| **Chemical** | |
| Overall Chemical Status | Fail |
| Priority Substances | Good |
| Cypermethrin (Priority hazardous) | Good |
| Fluoranthene | Good |
| Priority hazardous substances | Fail |
| Polybrominated diphenyl ethers (PBDE) | Fail |
| Perfluorooctane sulphonate (PFOS) | Fail |
| Benzo(a)pyrene | Good |
| Dioxins and dioxin-like compounds | Good |
| Heptachlor and cis-Heptachlor epoxide | Good |
| Hexabromocyclododecane (HBCDD) | Good |
| Hexachlorobenzene | Good |
| Hexachlorobutadiene | Good |
| Mercury and Its Compounds | Good |
| **Hydromorphological Quality Elements** | |
| Hydromorphology Supporting Elements Status | Supports Good |
| Hydrological Regime | Supports Good |

**Table C-3 - WFD status of the Ouzel DS Caldecote Mill (GB105033037972) water body potentially impacted by the Scheme**

| Water Body ID | GB105033037972 |
|---|---|
| Water Body Name | Ouzel DS Caldecote Mill |
| Water Body Type | River |
| Water Body Area | 10.263 $km^2$ |
| Hydromorphological Designation | not designated artificial or heavily modified |
| Overall Ecological Status | Moderate |
| Current Overall Status | Moderate |
| Status Objective (overall) | Moderate by 2015 |
| Justification | Unfavourable balance of costs and benefits |
| **Biological Quality Elements** | |
| Overall Biological Quality Element Status Objective | Good by 2015 |
| Invertebrates | Good |
| **Physico-chemical Quality Elements** | |
| Ammonia (Phys-Chem) | High |
| Dissolved Oxygen | High |
| pH | High |
| Phosphate | Moderate |
| Temperature | High |
| Overall Physico-Chemical Quality Element Status Objective | Moderate by 2015 (Unfavourable balance of costs and benefits) |
| **Chemical** | |
| Overall Chemical Status | Fail |
| Priority Substances | Good |
| Cypermethrin (Priority hazardous) | Good |
| Fluoranthene | Good |
| Priority hazardous substances | Fail |
| Anthracene | Good |

| | |
|---|---|
| Polybrominated diphenyl ethers (PBDE) | Fail |
| Perfluorooctane sulphonate (PFOS) | Fail |
| Benzo(a)pyrene | Good |
| Dioxins and dioxin-like compounds | Good |
| Benzo(b)fluoranthene | Good |
| Benzo(g-h-i)perylene | Good |
| Benzo(k)fluoranthene | Good |
| Heptachlor and cis-Heptachlor epoxide | Good |
| Hexabromocyclododecane (HBCDD) | Good |
| Hexachlorobenzene | Good |
| Hexachlorobutadiene | Good |
| Mercury and Its Compounds | Good |
| **Hydromorphological Quality Elements** | |
| Hydromorphology Supporting Elements Status | Supports Good |
| Hydrological Regime | Supports Good |

Three White Rose Office Park
Millshaw Park Lane
Leeds
LS11 0DL

**wsp.com**

# Appendix L4
## HEWRAT Assessment

# Milton Keynes East HEWRAT Assessment

| | | | |
|---|---|---|---|
| **DATE:** | 26 March 2021 | **CONFIDENTIALITY:** | Public |
| **SUBJECT:** | HEWRAT Technical Note | | |
| **PROJECT:** | 70057521 - MKE | **AUTHOR:** | Marta Ibanez / Aidan Wilks Daly |
| **CHECKED:** | Andy Smith | **APPROVED:** | Andy Smith |

## INTRODUCTION

To support the Water Environment and Drainage assessment, the Highways England Water Risk Assessment Tool (HEWRAT) has been used to assess how key pollutants from the surface water runoff from the arterial highway network may impact on the quality of the receiving waterbodies. This has been achieved through assessing the impacts at each of the proposed highway outfalls.

The assessment has been undertaken based on the proposed highways design (as detailed within the accompanying Surface Water Drainage Strategy), this details that the highway will drain via 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.

Routine Runoff (both surface and groundwater) and Spillage Risk Assessments have been undertaken for each of the nine outfalls and are detailed below.

## RIVER OUZEL ROUTINE RUNOFF ASSESSMENT

The step 1 (Runoff Quality) Assessment for the River Ouzel was based on traffic data from the traffic model developed for the Scheme, with the climatic region and rainfall site determined by the Scheme location.

For the step 2 (River Impacts) assessment, cross-sectional data (derived from the hydraulic model) was used to estimate the bed width, side slope and long slope of the River Ouzel, with annual $Q_{95}$ and Base Flow Index (BFI) values derived using the LowFlows software. The impermeable and permeable areas drained were based on the accompanying highway layouts, current at the time of preparation. A desk based review did not identify any downstream structures, lakes, pond or canals within 100m of the point of discharge for any of the outfalls and there are no protected sites for conservation (which the guidance defines as Ramsar, SSSI, WPZ, SPA and SAC or salmonid waters) within 1km of any of the outfalls.

Each outfall (1, 5 & 9) on the River Ouzel passed the routine runoff assessment as did the cumulative assessment of the three outfalls, with the results shown in Figures 1 – 4.

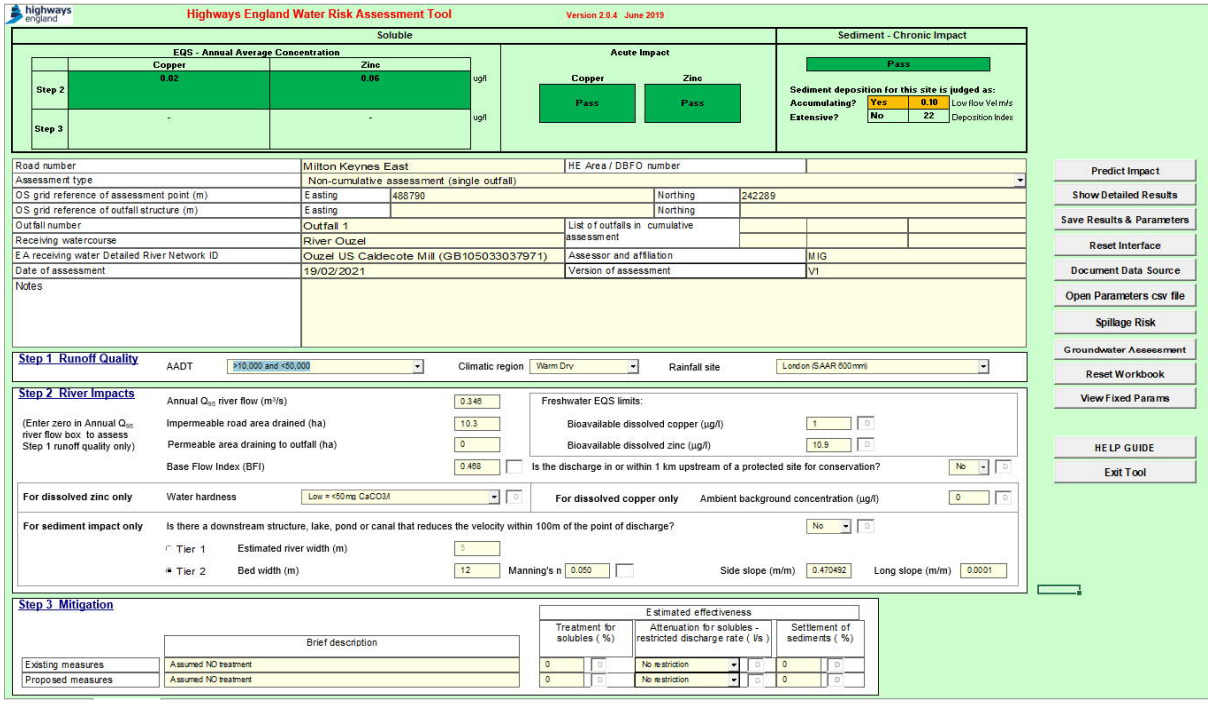


*Figure 1: River Ouzel Outfall 1 results*

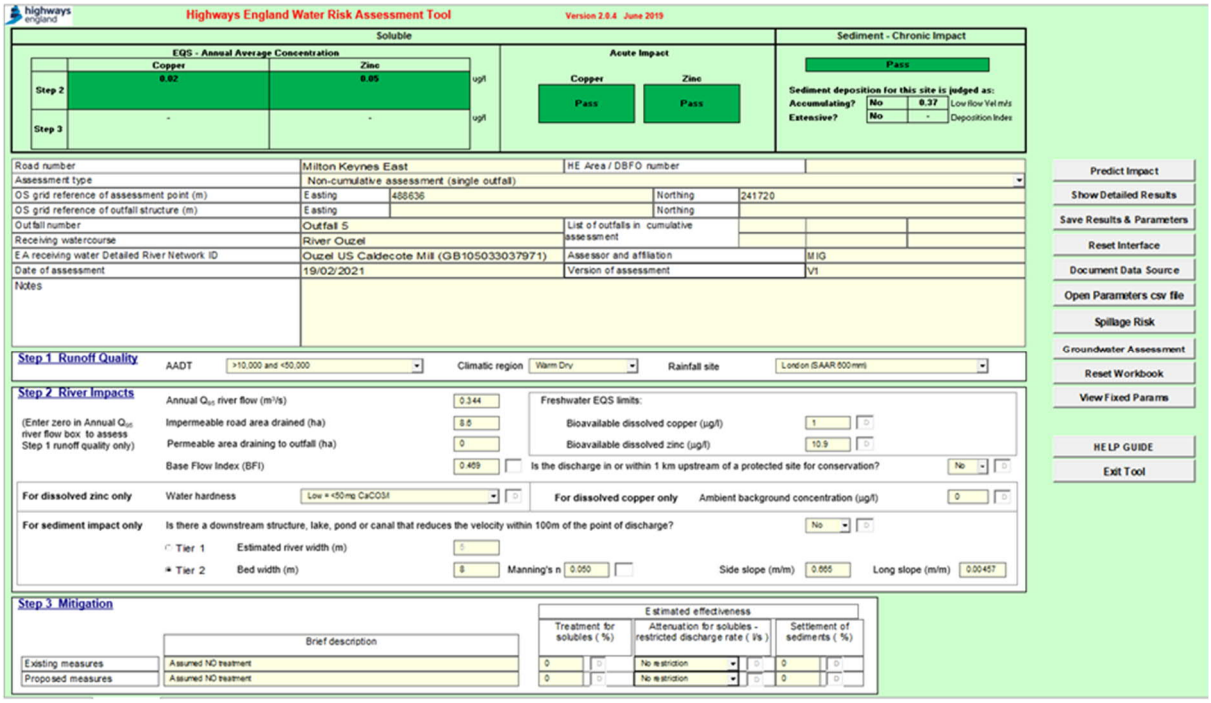


*Figure 2: River Ouzel Outfall 5 results*

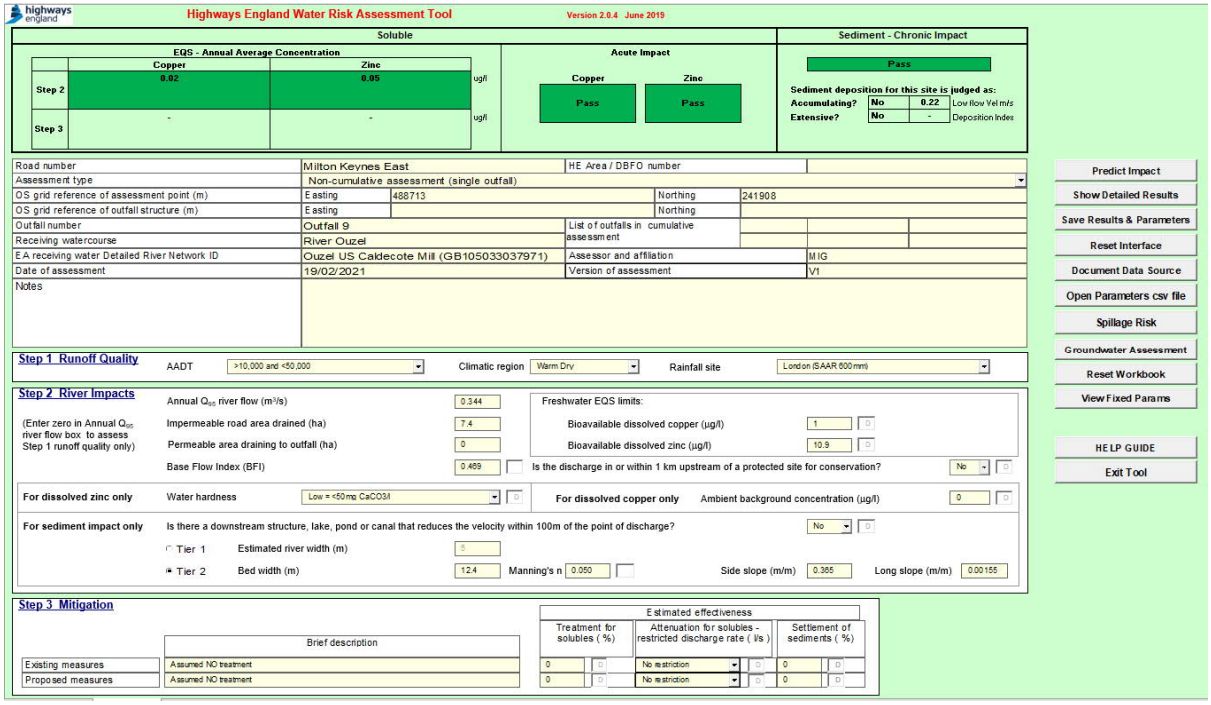


*Figure 3: River Ouzel Outfall 9 results*

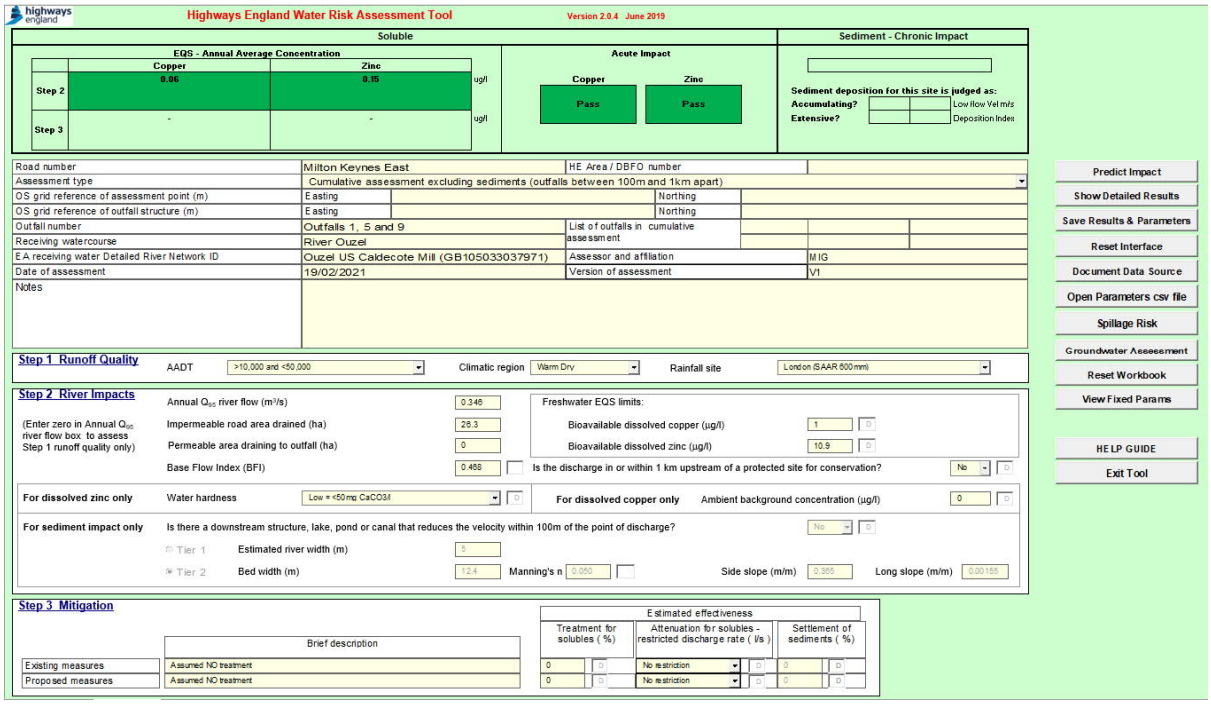


*Figure 4: River Ouzel cumulative results (Outfalls 1,5 & 9)*

# GROUNDWATER ASSESSMENTS

The outfalls draining to the Moulsoe Stream, the Hermitage Stream and the Barn Stream require a groundwater quality routine runoff assessment, as these watercourses have $Q_{95}$ values below 1 l/s. The results and parameters for each outfall are presented by watercourse.

## Moulsoe Stream

OUTFALL 2:

- 2048 DS AADT = 15,563
- Rainfall depth < 740mm[1]
- Drainage Area ratio = drainage area of road/active surface area of infiltration device
  - Outfall 2
  - Impermeable area = 3.2ha
  - Detention basin area = 1,100m$^2$ (according to the preliminary design) = 0.11ha
  - Drainage area ration = 3.2/0.11 = 29
- Infiltration Method = Continuous (drain)
- Unsaturated Zone = <=5m Phase 1 GI shows a number of boreholes and trial pits where groundwater was encountered between 1.50m and 6.90m.
- Flow Type – this is through the superficial deposits, therefore it is 'Dominantly intergranular flow' based on the presence of Diamicton and clay.
- Unsaturated Zone Clay Content – the GI Logs note a large presence of clay, so it has been assumed that there is >=15% clay minerals.
- Organic Carbon = the organic matter tests on the Phase 1 GI varied between <0.1% to 6.2%, so <15% to >1% of SOM has been selected.
- Unsaturated zone soil pH - the results from Phase 1 GI varied between 7.3 and 9.9, therefore a range between 5 and 8 has been selected.

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Reset GW Assessment | Go To Interface

Groundwater Assessment

| Component Number | | Weighting Factor | Property or Parameter | Risk Score | Component score | Weighted component score |
|---|---|---|---|---|---|---|
| 1 | SOURCE | 10 | Traffic flow | <=50,000 AADT | 1 | 10 |
| 2 | | 10 | Rainfall depth (annual averages) | <=740 mm rainfall | 1 | 10 |
| 3 | | 10 | Drainage area ratio | <=50 | 1 | 10 |
| 4 | PATHWAY | 15 | Infiltration method | "Continuous", shallow linear (e.g. unlined ditch, swale, grassed channel) | 1 | 15 |
| 5 | | 20 | Unsaturated zone | Depth to water table <=5 m | 3 | 60 |
| 6 | | 20 | Flow type (Incorporates flow type an effective grain size) | Dominantly intergranular flow (e.g. non-fractured consolidated deposits or unconsolidated deposits of fine-medium sand or finer) | 1 | 20 |
| 7 | | 5 | Unsaturated Zone Clay Content | >=15% clay minerals | 1 | 5 |
| 8 | | 5 | Organic Carbon | <15% to >1% SOM | 2 | 10 |
| 9 | | 5 | Unsaturated zone soil pH | pH <8 to >5 | 2 | 10 |

| | |
|---|---|
| TOTAL SCORE | 150 |
| RISK SCREENING LEVEL | Medium |

*Figure 5: Moulsoe Stream Outfall 2 Groundwater assessment results*

OUTFALL 3:

- 2048 DS AADT = 15,563
- Rainfall depth < 740mm[1]
- Drainage Area ratio = drainage area of road/active surface area of infiltration device
  - Outfall 2
  - Impermeable area = 10.3ha
  - Detention basin area = 1,000m$^2$ (according to the preliminary design) = 0.10ha
  - Drainage area ration = 10.3/0.10 = 103

[1] https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/weather/learn-about/uk-past-events/regional-climates/southern-england_-climate---met-office.pdf

- Infiltration Method = Continuous (drain)
- Unsaturated Zone = <=5m Phase 1 GI shows a number of boreholes and trial pits where groundwater was encountered between 1.50m and 6.90m.
- Flow Type – this is through the superficial deposits, therefore it is 'Dominantly intergranular flow' based on the presence of Diamicton and clay.
- Unsaturated Zone Clay Content – the GI Logs noted a large presence of clay, so it has been assumed that there is >=15% clay minerals.
- Organic Carbon = the organic matter tests on the Phase 1 GI varied between <0.1% to 6.2%, so <15% to >1% of SOM has been selected.
- Unsaturated zone soil pH - the results from Phase 1 GI varied between 7.3 and 9.9, therefore a range between 5 and 8 has been selected.

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**Groundwater Assessment**

| Component Number | | Weighting Factor | Property or Parameter | Risk Score | Component score | Weighted component score |
|---|---|---|---|---|---|---|
| 1 | SOURCE | 10 | Traffic flow | <=50,000 AADT | 1 | 10 |
| 2 | | 10 | Rainfall depth (annual averages) | <=740 mm rainfall | 1 | 10 |
| 3 | | 10 | Drainage area ratio | >50 to <150 | 2 | 20 |
| 4 | PATHWAY | 15 | Infiltration method | "Continuous", shallow linear (e.g. unlined ditch, swale, grassed channel) | 1 | 15 |
| 5 | | 20 | Unsaturated zone | Depth to water table <=5 m | 3 | 60 |
| 6 | | 20 | Flow type (Incorporates flow type an effective grain size) | Dominantly intergranular flow (e.g. non-fractured consolidated deposits or unconsolidated deposits of fine-medium sand or finer) | 1 | 20 |
| 7 | | 5 | Unsaturated Zone Clay Content | >=15% clay minerals | 1 | 5 |
| 8 | | 5 | Organic Carbon | <15% to >1% SOM | 2 | 10 |
| 9 | | 5 | Unsaturated zone soil pH | pH <8 to >5 | 2 | 10 |

| | |
|---|---|
| TOTAL SCORE | 160 |
| RISK SCREENING LEVEL | Medium |

*Figure 6: Moulsoe Stream Outfall 3 Groundwater Assessment Results*

## OUTFALL 4

- 2048 DS AADT = 15,563
- Rainfall depth < 740mm[1]
- Drainage Area ratio = drainage area of road/active surface area of infiltration device
  - Outfall 4
  - Impermeable area = 1.7ha
  - Detention basin area = 1,000m$^2$ (according to the preliminary design) = 0.10ha
  - Drainage area ration = 1.7/0.10 = 17
- Infiltration Method = Continuous (drain)
- Unsaturated Zone = <=5m Phase 1 GI shows a number of boreholes and trial pits where groundwater was encountered between 1.50m and 6.90m.
- Flow Type – we this is through the superficial deposits, therefore it is 'Dominantly intergranular flow' based on the presence of Diamicton and clay
- Unsaturated Zone Clay Content – the GI Logs noted a large presence of clay, so it has been assumed that there is >=15% clay minerals.
- Organic Carbon = the organic matter tests on the Phase 1 GI varied between <0.1% to 6.2%, so <15% to >1% of SOM has been selected.
- Unsaturated zone soil pH - the results from Phase 1 GI varied between 7.3 and 9.9, therefore a range between 5 and 8 has been selected.

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Groundwater Assessment

| Component Number | | Weighting Factor | Property or Parameter | Risk Score | Component score | Weighted component score |
|---|---|---|---|---|---|---|
| 1 | SOURCE | 10 | Traffic flow | <=50,000 AADT | 1 | 10 |
| 2 | | 10 | Rainfall depth (annual averages) | <=740 mm rainfall | 1 | 10 |
| 3 | | 10 | Drainage area ratio | <=50 | 1 | 10 |
| 4 | PATHWAY | 15 | Infiltration method | "Continuous", shallow linear (e.g. unlined ditch, swale, grassed channel) | 1 | 15 |
| 5 | | 20 | Unsaturated zone | Depth to water table <=5 m | 3 | 60 |
| 6 | | 20 | Flow type (Incorporates flow type an effective grain size) | Dominantly intergranular flow (e.g. non-fractured consolidated deposits or unconsolidated deposits of fine-medium sand or finer) | 1 | 20 |
| 7 | | 5 | Unsaturated Zone Clay Content | >=15% clay minerals | 1 | 5 |
| 8 | | 5 | Organic Carbon | <15% to >1% SOM | 2 | 10 |
| 9 | | 5 | Unsaturated zone soil pH | pH <8 to >5 | 2 | 10 |

| | |
|---|---|
| TOTAL SCORE | 150 |
| RISK SCREENING LEVEL | Medium |

*Figure 7: Moulsoe Stream Outfall 4 Groundwater Assessment Results*

## OUTFALL 6

- 2048 DS AADT = 12,052
- Rainfall depth < 740mm[1]
- Drainage Area ratio = drainage area of road/active surface area of infiltration device
  - Outfall 6
  - Impermeable area = 2.2ha
  - Detention basin area = 450m$^2$ (according to the preliminary design) = 0.045ha
  - Drainage area ration = 2.2/0.045 = 49
- Infiltration Method = Continuous (drain)
- Unsaturated Zone = <=5m Phase 1 GI shows a number of boreholes and trial pits where groundwater was encountered between 1.50m and 6.90m.
- Flow Type – this is through the superficial deposits, therefore it is 'Dominantly intergranular flow' based on the presence of Diamicton and clay.
- Unsaturated Zone Clay Content – the GI Logs noted a large presence of clay, so it has been assumed that there is >=15% clay minerals.
- Organic Carbon = the organic matter tests on the Phase 1 GI varied between <0.1% to 6.2%, so <15% to >1% of SOM has been selected.
- Unsaturated zone soil pH - the results from Phase 1 GI varied between 7.3 and 9.9, therefore a range between 5 and 8 has been selected.

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Groundwater Assessment

| Component Number | | Weighting Factor | Property or Parameter | Risk Score | Component score | Weighted component score |
|---|---|---|---|---|---|---|
| 1 | SOURCE | 10 | Traffic flow | <=50,000 AADT | 1 | 10 |
| 2 | | 10 | Rainfall depth (annual averages) | <=740 mm rainfall | 1 | 10 |
| 3 | | 10 | Drainage area ratio | <=50 | 1 | 10 |
| 4 | PATHWAY | 15 | Infiltration method | "Continuous", shallow linear (e.g. unlined ditch, swale, grassed channel) | 1 | 15 |
| 5 | | 20 | Unsaturated zone | Depth to water table <=5 m | 3 | 60 |
| 6 | | 20 | Flow type (Incorporates flow type an effective grain size) | Dominantly intergranular flow (e.g. non-fractured consolidated deposits or unconsolidated deposits of fine-medium sand or finer) | 1 | 20 |
| 7 | | 5 | Unsaturated Zone Clay Content | >=15% clay minerals | 1 | 5 |
| 8 | | 5 | Organic Carbon | <15% to >1% SOM | 2 | 10 |
| 9 | | 5 | Unsaturated zone soil pH | pH <8 to >5 | 2 | 10 |

| | |
|---|---|
| TOTAL SCORE | 150 |
| RISK SCREENING LEVEL | Medium |

*Figure 8: Moulsoe Stream Outfall 6 Groundwater Assessment Results*

## Hermitage Stream

### OUTFALL 7

- 2048 DS AADT = 1,907
- Rainfall depth < 740mm[1]
- Drainage Area ratio = drainage area of road/active surface area of infiltration device
  - Outfall 7
  - Impermeable area = 1.4ha
  - Detention basin area to the north = 600m$^2$ (according to the preliminary design) = 0.06ha
  - Drainage area ration = 1.4/0.06 = 23
- Infiltration Method = Continuous (drain)
- Unsaturated Zone = <=5m Phase 1 GI shows a number of boreholes and trial pits where groundwater was encountered between 1.50m and 6.90m.
- Flow Type – this is through the superficial deposits, therefore it is 'Dominantly intergranular flow' based on the presence of Diamicton and clay.
- Unsaturated Zone Clay Content – the GI Logs noted a large presence of clay, so it has been assumed that there is >=15% clay minerals.
- Organic Carbon = the organic matter tests on the Phase 1 GI varied between <0.1% to 6.2%, so <15% to >1% of SOM has been selected.
- Unsaturated zone soil pH - the results from Phase 1 GI varied between 7.3 and 9.9, therefore a range between 5 and 8 has been selected.

highways england

Reset GW Assessment | Go To Interface

Groundwater Assessment

| Component Number | | Weighting Factor | Property or Parameter | Risk Score | Component score | Weighted component score |
|---|---|---|---|---|---|---|
| 1 | SOURCE | 10 | Traffic flow | <=50,000 AADT | 1 | 10 |
| 2 | | 10 | Rainfall depth (annual averages) | <=740 mm rainfall | 1 | 10 |
| 3 | | 10 | Drainage area ratio | <=50 | 1 | 10 |
| 4 | PATHWAY | 15 | Infiltration method | "Continuous", shallow linear (e.g. unlined ditch, swale, grassed channel) | 1 | 15 |
| 5 | | 20 | Unsaturated zone | Depth to water table <=5 m | 3 | 60 |
| 6 | | 20 | Flow type (Incorporates flow type an effective grain size) | Dominantly intergranular flow (e.g. non-fractured consolidated deposits or unconsolidated deposits of fine-medium sand or finer) | 1 | 20 |
| 7 | | 5 | Unsaturated Zone Clay Content | >=15% clay minerals | 1 | 5 |
| 8 | | 5 | Organic Carbon | <15% to >1% SOM | 2 | 10 |
| 9 | | 5 | Unsaturated zone soil pH | pH <8 to >5 | 2 | 10 |

| | |
|---|---|
| TOTAL SCORE | 150 |
| RISK SCREENING LEVEL | Medium |

*Figure 9:Hermitage Stream Outfall 7 Groundwater Assessment Results*

## Barn Stream

### OUTFALL 8

- 2048 DS AADT = 1,907
- Rainfall depth < 740mm [1]
- Drainage Area ratio = drainage area of road/active surface area of infiltration device
  - Outfall 8
  - Impermeable area = 5.6ha
  - Detention basin area to the north = 600m$^2$ (according to the preliminary design) = 0.06ha
  - Drainage area ration = 5.6/0.06 = 93
- Infiltration Method = Continuous (drain)
- Unsaturated Zone = <=5m Phase 1 GI shows a number of boreholes and trial pits where groundwater was encountered between 1.50m and 6.90m.
- Flow Type – this is through the superficial deposits, therefore it is 'Dominantly intergranular flow' based on the presence of Diamicton and clay.
- Unsaturated Zone Clay Content – the GI Logs noted a large presence of clay, so it has been assumed that there is >=15% clay minerals.
- Organic Carbon = the organic matter tests on the Phase 1 GI varied between <0.1% to 6.2%, so <15% to >1% of SOM has been selected.
- Unsaturated zone soil pH - the results from Phase 1 GI varied between 7.3 and 9.9, therefore a range between 5 and 8 has been selected.

highways england

Reset GW Assessment | Go To Interface

Groundwater Assessment

| Component Number | | Weighting Factor | Property or Parameter | Risk Score | Component score | Weighted component score |
|---|---|---|---|---|---|---|
| 1 | SOURCE | 10 | Traffic flow | <=50,000 AADT | 1 | 10 |
| 2 | | 10 | Rainfall depth (annual averages) | <=740 mm rainfall | 1 | 10 |
| 3 | | 10 | Drainage area ratio | >50 to <150 | 2 | 20 |
| 4 | PATHWAY | 15 | Infiltration method | "Continuous", shallow linear (e.g. unlined ditch, swale, grassed channel) | 1 | 15 |
| 5 | | 20 | Unsaturated zone | Depth to water table <=5 m | 3 | 60 |
| 6 | | 20 | Flow type (Incorporates flow type an effective grain size) | Dominantly intergranular flow (e.g. non-fractured consolidated deposits or unconsolidated deposits of fine-medium sand or finer) | 1 | 20 |
| 7 | | 5 | Unsaturated Zone Clay Content | >=15% clay minerals | 1 | 5 |
| 8 | | 5 | Organic Carbon | <15% to >1% SOM | 2 | 10 |
| 9 | | 5 | Unsaturated zone soil pH | pH <8 to >5 | 2 | 10 |

| | |
|---|---|
| TOTAL SCORE | 160 |
| RISK SCREENING LEVEL | Medium |

*Figure 10: Barn Stream Outfall 8 Groundwater Assessment Results*

## Routine Runoff Conclusions

### SURFACE WATER

All the outfalls draining to the River Ouzel individually pass the routine runoff assessment as does the cumulative assessment of the three outfalls.

### GROUNDWATER

All the outfalls (Moulsoe, Hermitage and Barn Streams) are on the threshold of Low to Medium risk. In this scenario the guidance within the DMRB[2] 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".*

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).

# SPILLAGE RISK ASSESSMENT

During operation of any highway, there is a risk that road traffic accidents or vehicle fires may result in spillage of potential pollutants on the road surface. Should this occur then pollutants may enter the road drainage network and subsequently be discharged to the water environment, causing an acute pollution event.

[2] https://www.standardsforhighways.co.uk/prod/attachments/d6388f5f-2694-4986-ac46-b17b62c21727

The acceptable limit for spillages to sensitive watercourses, as detailed within the DMRB, is 1 in 200 year return period (0.5% probability). If spillages are predicted to be more frequent than this then mitigation measures are required. The spillage risk assessment (Figure 11) demonstrates that despite utilising conservatively high traffic data, the surface water infrastructure is within the acceptable limits, with the highest risk drainage network (Cumulative Drainage Network Outfalls 1, 9 and 5) having a spillage risk return period of 1 in 299 years. This demonstrates that no further mitigation is required.

Although no specific spillage risk mitigation is required, it should be noted that the ponds and other sustainable drainage techniques, which are to be included within the drainage infrastructure during detailed design, would also provide containment and treatment following a spillage incident, thus lowering the risk further.

Spillage Calculations
Formula
RL x SS x (AADT x 365 x $10^{-9}$) x (%HGV /100)

| Outfall Network | Road Length (km) | Road Type | Junction Type | Spillage Accident Rates (SS) | AADT24-2way | %HGV | $p^{vol}$ | $p^{mol}$ | $p^{inc}$ | Outfall Risk | Overall Prob. | Designated Area <1km | Annual Probability 1 in x | RANK | Annual Probability 1 in x |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 0.19 | Urban | Roundabout | 5.35 | 41500 | 2 | 0.000299942 | 0.75 | 0.000224957 | 0.000224957650708750 | 0.000224957 | No | 4445 | 6 | 3,060 |
| 1 | 0.10 | Urban | Roundabout | 5.35 | 19684 | 3 | 0.000115314 | 0.75 | 8.64853E-05 | 0.000086485345475000 | 0.000086485 | No | 11563 | 15 | |
| 1 | 0.31 | Urban | No Junction | 0.31 | 19777 | 3 | 2.0532E-05 | 0.75 | 1.5399E-05 | 0.000015398973618570 | 0.000015399 | No | 64939 | 29 | |
| 9 | 0.18 | Urban | Roundabout | 5.35 | 30701 | 2 | 0.000210645 | 0.75 | 0.000157984 | 0.000157984838706468 | 0.000157984 | No | 6330 | 10 | 1,046 |
| 9 | 0.10 | Urban | Roundabout | 5.35 | 26600 | 2 | 0.000103886 | 0.75 | 7.79147E-05 | 0.000077914725000000 | 0.000077915 | No | 12835 | 17 | |
| 9 | 0.54 | Urban | No Junction | 0.31 | 26600 | 2 | 3.26616E-05 | 0.75 | 2.44962E-05 | 0.000024496229341500 | 0.000024496 | No | 40823 | 26 | |
| 9 | 0.10 | Urban | Roundabout | 5.35 | 30701 | 2 | 0.000119903 | 0.75 | 8.99271E-05 | 0.000089927065662500 | 0.000089927 | No | 11120 | 13 | |
| 9 | 0.15 | Urban | Roundabout | 5.35 | 40512 | 2 | 0.000239117 | 0.75 | 0.000179338 | 0.000179337979245600 | 0.000179338 | No | 5576 | 9 | |
| 9 | 0.10 | Urban | Roundabout | 5.35 | 41581 | 2 | 0.000162395 | 0.75 | 0.000121796 | 0.000121795946625000 | 0.000121796 | No | 8210 | 11 | |
| 9 | 0.16 | Urban | Roundabout | 5.35 | 40512 | 2 | 0.000259844 | 0.75 | 0.000194883 | 0.000194883053651760 | 0.000194883 | No | 5131 | 8 | |
| 9 | 0.37 | Urban | No Junction | 0.31 | 30701 | 2 | 2.57639E-05 | 0.75 | 1.93229E-05 | 0.000019323293976847 | 0.000019323 | No | 51752 | 27 | |
| 9 | 0.10 | Urban | Roundabout | 5.35 | 12496 | 4 | 9.76063E-05 | 0.75 | 7.32047E-05 | 0.000073204692000000 | 0.000073205 | No | 13660 | 18 | |
| 9 | 0.41 | Urban | No Junction | 0.31 | 12335 | 4 | 2.30174E-05 | 0.75 | 1.72631E-05 | 0.000017263059525680 | 0.000017263 | No | 57927 | 28 | |
| 5 | 0.15 | Urban | No Junction | 0.31 | 12040 | 6 | 1.24906E-05 | 0.75 | 9.36797E-06 | 0.000009367966622700 | 0.000009368 | No | 106747 | 31 | 486 |
| 5 | 0.17 | Urban | Roundabout | 5.35 | 25691 | 9 | 0.000760844 | 0.75 | 0.000570633 | 0.000570633293686110 | 0.000570633 | No | 1752 | 1 | |
| 5 | 0.10 | Urban | Roundabout | 5.35 | 25691 | 9 | 0.000451513 | 0.75 | 0.000338635 | 0.000338634676687500 | 0.000338635 | No | 2953 | 4 | |
| 5 | 0.10 | Urban | Roundabout | 5.35 | 25691 | 9 | 0.000451513 | 0.75 | 0.000338635 | 0.000338634676687500 | 0.000338635 | No | 2953 | 4 | |
| 5 | 0.10 | Urban | Roundabout | 5.35 | 25691 | 9 | 0.000451513 | 0.75 | 0.000338635 | 0.000338634676687500 | 0.000338635 | No | 2953 | 4 | |
| 5 | 0.11 | Urban | Roundabout | 5.35 | 25691 | 9 | 0.000515808 | 0.75 | 0.000386856 | 0.000386856254647800 | 0.000386856 | No | 2585 | 2 | |
| 5 | 0.33 | Urban | No Junction | 0.31 | 25691 | 9 | 8.5177E-05 | 0.75 | 6.38828E-05 | 0.000063882767146980 | 0.000063883 | No | 15654 | 20 | |
| 5 | 0.24 | Urban | No Junction | 0.31 | 14085 | 4 | 1.54246E-05 | 0.75 | 1.15685E-05 | 0.000011568478403700 | 0.000011568 | No | 86442 | 30 | |
| 4 | 0.18 | Urban | Roundabout | 5.35 | 12661 | 2 | 8.76853E-05 | 0.75 | 6.5764E-05 | 0.000065763986026610 | 0.000065764 | No | 15206 | 19 | 4,779 |
| 4 | 0.10 | Urban | Roundabout | 5.35 | 12661 | 2 | 4.94475E-05 | 0.75 | 3.70857E-05 | 0.000037085651625000 | 0.000037086 | No | 26965 | 23 | |
| 4 | 0.10 | Urban | Roundabout | 5.35 | 12661 | 2 | 4.94475E-05 | 0.75 | 3.70857E-05 | 0.000037085651625000 | 0.000037086 | No | 26965 | 23 | |
| 4 | 0.08 | Urban | Roundabout | 5.35 | 12661 | 2 | 3.75999E-05 | 0.75 | 2.81999E-05 | 0.000028199929495650 | 0.000028200 | No | 35461 | 25 | |
| 4 | 0.10 | Urban | Roundabout | 5.35 | 12661 | 2 | 4.94475E-05 | 0.75 | 3.70857E-05 | 0.000037085651625000 | 0.000037086 | No | 26965 | 23 | |
| 4 | 0.13 | Urban | No Junction | 0.31 | 11834 | 3 | 5.36196E-06 | 0.75 | 4.02147E-06 | 0.000004021470056430 | 0.000004021 | No | 248665 | 33 | |
| 6 | 0.19 | Urban | Roundabout | 5.35 | 12052 | 6 | 0.000270878 | 0.75 | 0.000203158 | 0.000203158412266050 | 0.000203158 | No | 4922 | 7 | 1,906 |
| 6 | 0.10 | Urban | Roundabout | 5.35 | 19777 | 3 | 0.00011945 | 0.75 | 8.95877E-05 | 0.000089587670375810 | 0.000089588 | No | 11162 | 14 | |
| 6 | 0.10 | Urban | Roundabout | 5.35 | 26600 | 2 | 0.000106286 | 0.75 | 7.97146E-05 | 0.000079714555147500 | 0.000079715 | No | 12545 | 16 | |
| 6 | 0.16 | Urban | No Junction | 0.31 | 19777 | 3 | 1.0515E-05 | 0.75 | 7.88628E-06 | 0.000007886284455520 | 0.000007886 | No | 126802 | 32 | |
| 6 | 0.09 | Urban | Roundabout | 5.35 | 12052 | 6 | 0.000133229 | 0.75 | 9.99218E-05 | 0.000099921785942250 | 0.000099922 | No | 10008 | 12 | |
| 6 | 0.10 | Urban | Roundabout | 5.35 | 15089 | 2 | 5.90126E-05 | 0.75 | 4.42594E-05 | 0.000044259443718980 | 0.000044259 | No | 22594 | 21 | |

Cumulatives

| Outfalls ID | Overall Prob. | Annual Probability 1 in x |
|---|---|---|
| | | |
| 4 & 6 | 0.000733770 | 1,363 |
| 1, 9 & 5 | 0.003341183 | 299 |

*Figure 11: Spillage Risk Assessment Results*