

# **A12 Chelmsford to A120 widening scheme**

**TR010060**

## **DEVELOPMENT CONSENT ORDER CHANGE APPLICATION CONSULTATION**

### **B1023 Flood Mitigation and Drainage Technical Note**

Rule 113 and 114  
Infrastructure Planning (Examination Procedure)  
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# 1 Introduction

## 1.1 Background

- 1.1.1 An application seeking a development consent order (DCO) for the A12 Chelmsford to A120 widening scheme (the proposed scheme) was submitted by National Highways to the Secretary of State for Transport via the Planning Inspectorate on 15 August 2022 and accepted for Examination on 12 September 2022.
- 1.1.2 The Examination started on 12 January 2023 and is expected to finish on 12 July 2023.
- 1.1.3 Since the DCO application was made, National Highways has continued to engage and refine designs to identify opportunities to further improve the proposals. As a result of this, National Highways are consulting on changes to the proposed scheme during the Examination stage to address interested parties' suggestions and implement improvements to the proposed scheme.
- 1.1.4 This targeted DCO change application consultation reflects design changes to the DCO application that we are proposing. These changes are as a result of the continued design evolution, detailed design progressing in parallel with the application, and continued engagement with stakeholders, interested parties and our delivery partners.
- 1.1.5 Map books have been created to support the consultation which show the key DCO drawings which would be affected by the proposed change.
- 1.1.6 The draft DCO application can be found on the Planning Inspectorate's website at the following link  
<https://infrastructure.planninginspectorate.gov.uk/projects/eastern/a12-chelmsford-to-a120-widening-scheme/>
- 1.1.7 References to the DCO application or subsequent documents submitted during the Examination will be made in this report, the document reference number will be written in square brackets and all documents with a reference number can be found in the Examination Library on the Planning Inspectorate's website.

## 1.2 Changes being made

- 1.2.1 The purpose of this document is to explain the proposed changes to the design of the highway drainage and flood mitigation infrastructure in the vicinity of the B1023 near Inworth, from the design that was submitted with the DCO application on 15 August 2022. In this document the A12 Chelmsford to A120 Widening Scheme is referred to as the "proposed scheme" and the proposed changes to the design of drainage and flood mitigation infrastructure in the vicinity of the B1023 near Inworth are referred to as the "new design". The new design is entirely within the proposed scheme Order Limits that were submitted in August 2022. Refer to consultation Map Book 4, Land Plans - Sheet 14 of 21 and Sheet 20 of 21.

1.2.2 The new design results in a material reduction in the land requirements from the design that was submitted as part of the DCO application. This document summarises the new design proposals and describes the assessment undertaken on the implications of the proposed change for landtake in addition to the identification and assessment of environmental impacts in the Environmental Statement (ES) submitted with the DCO application.

## 1.3 Reason behind changes

1.3.1 Subsequent to the submission of the DCO Application in August 2022, additional surveys and site investigations have been undertaken as part of the design development process. The new design has been developed using this additional information to refine the highway drainage and flood mitigation proposals in the vicinity of the B1023 near Inworth. The additional information and the design refinement work undertaken includes:

- Site surveys, in particular of the existing drainage network (referred to as “post-submission drainage surveys” hereafter), but also topographic and utilities surveys.
- Hydraulic modelling of watercourses. A lack of available information on the existing drainage network meant that the hydraulic modelling of watercourses was not undertaken for the design submitted in August 2022, which was accordingly based on a worst case approach. With the additional information received, a hydraulic model has been built and used to refine the design of the proposed flood mitigation measures.
- The post-submission drainage surveys improved the understanding of the existing highway drainage. The surveys have been used to refine the highway drainage design and proposed attenuation ponds submitted with the DCO application in August 2022.

1.3.2 Several relevant representations identified the extensive landtake for the flood mitigation measures and attenuation ponds for the design submitted in August 2022 as being of concern and therefore further assessment has been undertaken to attempt to address these concerns.

1.3.3 The new design takes account of the location of an existing high pressure (HP) gas main that crosses the B1023 road. The design submitted in August 2022 included flood mitigation storage areas that would have required excavation over this gas main, the location of which was unknown at DCO design. The location of other underground services along the B1023 was also made available post-submission of the DCO and used for the new design. The highway drainage attenuation storage ponds and watercourse flood mitigation storage areas have been adjusted in the new design to minimise the impact on the existing foul sewer that crosses and runs alongside the B1023.

1.3.4 The post-submission drainage surveys confirmed that there is an existing damaged manhole chamber within the highway drainage network along the B1023 road. The damage to this chamber means the existing highway drainage is not functioning as it should. The existing highway drainage serving the B1023 road is described further in Section 2.3 (i.e. within the “Existing Highway

Drainage” sub-section) The post-submission drainage survey information enabled a hydraulic model to be built such that, when the damaged manhole was represented, it generated existing scenario results that better matched reports of flooding received from stakeholders. The hydraulic model has therefore been used to represent the baseline scenario and gives an improved understanding of the existing flood risk than was available for the design submitted in August 2022. The new baseline modelling resulted in a reduction of flood water reaching the B1023 road near Inworth compared to that calculated for the design submitted in August 2022. Furthermore, the new baseline modelling also shows that a greater conveyance of flood water away from the road would be possible with a repaired highway drainage system than had previously been assumed, while keeping the highway drainage system separate from the watercourse.

## **2 Design assessment approach**

### **2.1 Design principles**

2.1.1 The new design follows the flood risk assessment principles outlined in the Flood Risk Assessment (FRA) submitted with DCO application [APP-162] regarding the flood risk assessment of Ordinary Watercourses and any associated flood risk mitigation measures. Similarly, the highway drainage design principles outlined in the Surface Water Drainage Strategy [APP-174] have been used in the new design of the proposed highway drainage elements.

### **2.2 Hydraulic modelling approach for watercourses**

- 2.2.1 Hydraulic modelling has been undertaken of Ordinary Watercourse 34 and its tributaries, which is the primary watercourse that flows from south to north alongside the B1023 road. The watercourse hydraulic model uses a two-dimensional (2D) schematisation built in TUFLOW software, with 1D elements used for culverts where appropriate. The hydraulic model is focussed on the watercourses and the flooding from these and surface water flows associated with the watercourse catchment. The highway drainage is represented in a separate hydraulic model. A high level description of the hydraulic modelling approach undertaken for the new design of highway drainage is presented in Section 2.3 of this document.
- 2.2.2 A hydrological assessment has been undertaken to provide inflows for the watercourses hydraulic model. These inflows have been applied to the hydraulic model as point inflows at appropriate locations.
- 2.2.3 A baseline (present day) hydraulic model has been run to identify the existing flood risk to the B1023 road from the watercourse. The changes to the B1023 near Inworth as a result of the proposed scheme have then been added to the model to allow for an assessment of what the flood risk to the proposed scheme would be and if there is any change to the existing flood risk. The proposed scheme hydraulic model has then been used to test the required mitigation including an allowance for climate change as specified in FRA [APP-162]. The assessment also accounts for the requirements for the existing drainage ditches

and the existing culverted watercourses impacted by the proposed scheme with their sizes being determined through hydraulic modelling.

- 2.2.4 The provision of flood mitigation storage areas in all of the areas identified in the design submitted in August 2022 as being required for that purpose has been considered as part of the reassessment work undertaken. The hydraulic model results have been used to identify which of the areas were most likely to provide sufficient attenuation storage in the most efficient way possible. The reassessment work undertaken for the watercourse flood mitigation storage areas has also taken into account the locations of the proposed highway drainage attenuation storage ponds such that the combined new design solution will make more efficient use of the land areas identified as being required. The new design provides a reduction in the area of land required permanently and is located entirely within the proposed scheme Order Limits that was submitted in August 2022. Refer to consultation Map Book 4, Land Plans - Sheet 14 of 21 and Sheet 20 of 21.

## 2.3 Highway drainage design rationalisation

### Existing highway drainage

- 2.3.1 The post-submission drainage surveys confirmed that the highway drainage runoff is primarily collected through traditional kerb inlet gullies and kerb/gully drainage arrangements, which generally appear to be drained using carrier drains and/or discharge to a number of highway drainage ditches which convey the collected runoff to Ordinary Watercourses located adjacent to the B1023 road. It is noted that some sections of the road appear to have no formal highway drainage system and rely on 'over-the-edge' drainage into nearby field ditches. It was also found that in some cases the existing highway drainage discharges directly into existing culverts that cross the B1023 road. For the new design where possible the direct discharge of proposed highway drainage outfalls to culverts is avoided in favour of discharging to an open ditch/watercourse.
- 2.3.2 The post-submission drainage surveys indicate the presence of damaged and / or collapsed pipework and damaged manhole chambers including the damaged manhole chamber described in Section 1.3.4 above. The presence of damaged pipework and manhole chambers is likely due to a lack of adequate highway drainage maintenance works being undertaken and results in a poorly functioning highway drainage system locally. The new design assumes that, where required, the existing highway drainage will be rehabilitated and upgraded as part of the proposed scheme. Where the existing highway drainage is impacted by the proposed highway widening works and / or inadequate hydraulic capacity such that it could not be retained then the affected existing highway drainage would either need replacement and/or upgrading.
- 2.3.3 It is noted that the presence of existing surface water attenuation features such as attenuation storage ponds, underground attenuation storage systems, flow control devices or pollution control measures were not found along the B1023

near Inworth. Similarly, the presence of soakaways and/or other infiltration techniques could not be confirmed.

- 2.3.4 The post-submission drainage surveys were found to be sufficient to inform a general understanding of the existing highway drainage features, drainage catchments and outfall locations in and around the B1023. There are some gaps in the drainage survey information for which appropriate design assumptions have been made in the new design that would need to be confirmed at detailed design stage. The existing highway drainage catchment extents for the new design are illustrated on Sheet 14 of 21 and Sheet 20 of 21 of Drainage and Surface Water Plans, and can be found within consultation Map Book 4.

### **Highway drainage design approach**

- 2.3.5 The new design of the proposed highway drainage elements is based on the highway improvement works and the subsequent receipt / assessment of further information on the existing highway drainage systems serving the B1023 near Inworth. The aforementioned further information on the existing highway drainage systems has helped to better understand existing drainage catchments and local outfall arrangements which has informed the new design for the highway drainage proposals.
- 2.3.6 The drainage catchment area extents, the proposed edge collection methods, the need to retain / relocate / upgrade any existing highway drainage, attenuation storage requirements and the proposed outfall locations have been assessed as part of the proposed highway drainage. The new design of the highway drainage proposals along the B1023 road is presented within consultation Map Book 4, Drainage and Surface Water Plan – Sheet 14 of 21 and Sheet 20 of 21. These plans illustrate the proposed highway drainage catchment extents, the existing highway drainage catchments to be retained (where applicable), the drainage ditch alignments, the proposed outfall locations, the proposed attenuation storage pond locations and other relevant drainage features for the B1023 near Inworth. The existing and proposed paved catchment areas and any permeable catchment areas draining into the proposed highway drainage systems for the proposed highway drainage catchments are presented in Table A.1 in Appendix A.
- 2.3.7 The new design of the proposed highway drainage elements has generally maintained the existing edge collection features, flow conveyance methods using carrier drains and discharge to highway drainage ditches and/or Ordinary Watercourses located adjacent to the B1023 road. Flow control devices will be provided as required to limit the proposed discharge rates to the existing site discharge rates and enable the attenuation of the collected surface water runoff. Use of combined kerb and gully drainage systems forms part of the new design where the hydraulic capacity of existing gullies/kerb inlets were found to be inadequate.

### **Highway drainage design criteria**

- 2.3.8 The new design of the proposed highway drainage for the B1023 near Inworth adheres to the highway drainage design criteria presented in Section 4 of the



Surface Water Drainage Strategy [APP-174] submitted at DCO. The key highway drainage design criteria and the associated specific references to sub-sections within Section 4 of the Surface Water Drainage Strategy [APP-174] are summarised below:

- Retention of the general location of the discharge points from the existing highway drainage where feasible in order to maintain flows in receiving watercourses as far as reasonably practicable. The allowable discharge rates criteria is specified in Sections 4.8 to 4.10, Section 7 and Section 10 of [APP-174].
- The provision of adequate attenuation storage measures. The attenuation storage design criteria is specified in Section 4.9 of [APP-174].
- The climate change allowance applied to the proposed highway drainage over the design life of the proposed scheme is specified in Section 4.4 of [APP-174].
- The hydraulic design criteria for the piped drainage systems is specified in Section 4.5.7 and Section 4.5.8 of [APP-174].
- Where feasible, Sustainable Drainage Systems (SuDS) flow conveyance and attenuation features (e.g. filter drains, attenuation storage ponds, etc.) are employed to minimise the flood risk and water quality impact of surface water runoff being discharged to the natural environment from the proposed highway drainage systems. This is as specified in Section 4.2 and Section 11 of [APP-174].
- The proposed highway is to remain operational and safe for users during major rainfall events and not increase flood risk elsewhere. The exceedance flows assessment methodology is specified in Section 9 of [APP-174].

### **Discharge rates and attenuation storage volumes**

- 2.3.9 The proposed catchment discharge rates, the associated flow control devices used to achieve the proposed discharge rates, the attenuation storage type used, and the resulting modelled attenuation storage volume estimates are presented in Table A.2 in Appendix A. Hydraulic modelling has been undertaken to determine the allowable discharge rates and attenuation storage volumes. The hydraulic modelling methodology employed is described in Section 5 of the Surface Water Drainage Strategy [APP-174]. The rainfall data and the various hydraulic modelling parameters that inform the hydraulic modelling are those presented in Section 4.6, of the Surface Water Drainage Strategy [APP-174].
- 2.3.10 Regarding the proposed highway drainage discharge rates, Table A.2 in Appendix A presents a summary table of the outfall locations for the proposed highway drainage systems. The modelled proposed case peak discharge rates for the 1 in 1-year, 1 in 2-year, 1 in 5-year and 1 in 100-year return period storm events (plus an allowance for climate change) for the critical storm event are presented. The proposed highway drainage attenuation storage volumes have been determined for design events up to and including the 1 in 100-year return

period storm event (plus an allowance for climate change) and the associated critical storm duration for the attenuation storage locations.

#### **Infiltration potential assessment**

- 2.3.11 Based on the findings of the preliminary ground investigation, in-situ testing undertaken to date has found that ground conditions are generally not suitable across the majority of the proposed scheme for SuDS using infiltration. Refer to Section 8 and associated Annex E of the Surface Water Drainage Strategy [APP-174] which assesses the ground investigation findings in depth with respect to the feasibility of using infiltration methods for the proposed scheme highway drainage catchments. Table A.4 in Appendix A summarises the ground investigation findings for the proposed attenuation storage ponds that are part of the new design of the highway drainage proposal for the B1023 near Inworth.

#### **Exceedance flows assessment**

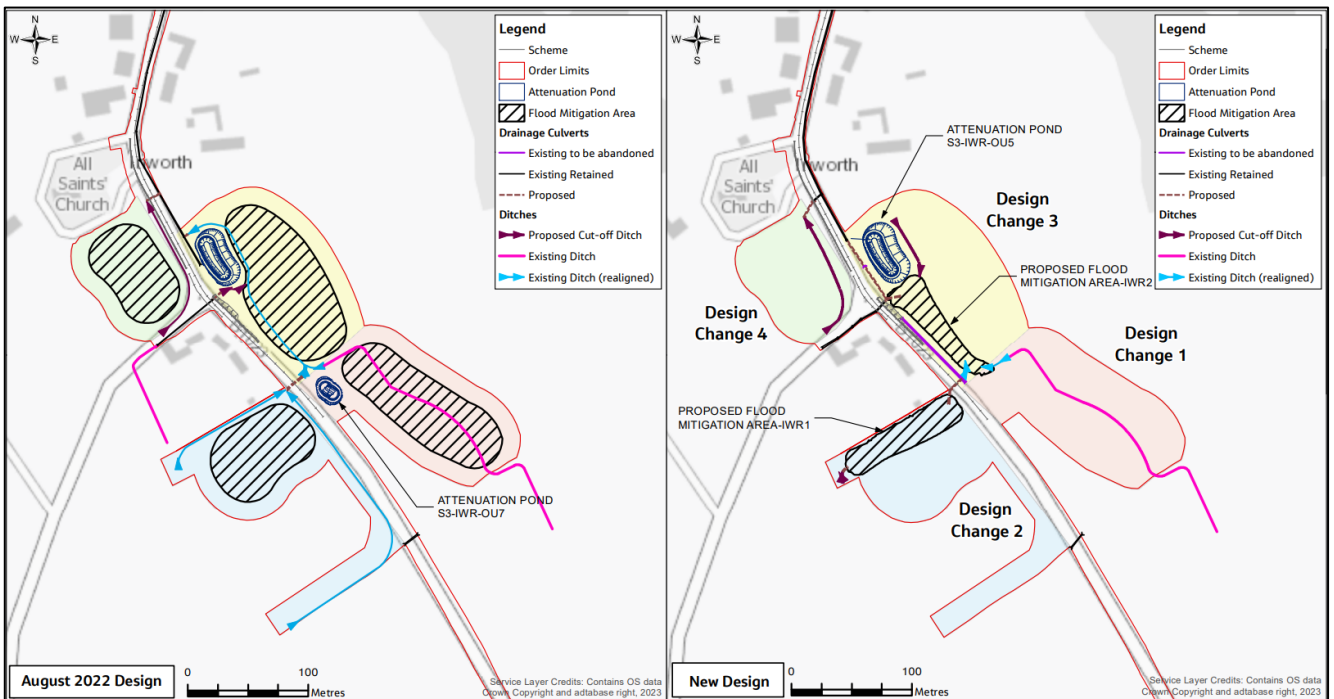
- 2.3.12 The assessment of exceedance flows from the proposed highway drainage systems has been undertaken to ensure that there is no increased surface water drainage flood risk to road users and to the third-party land outside the proposed scheme permanent acquisition of land boundary. Refer to Section 9 of the Surface Water Drainage Strategy [APP-174] for full details on the exceedance flows assessment criteria. The exceedance flow assessment results satisfy the stated design standard requirements quoted in Section 2.3.8 above.

### 3 Summary of the change

3.1.1 The proposed mitigation required for the highway drainage and flood risk infrastructure in the vicinity of the B1023, near Inworth, has been rationalised to reduce the number of watercourse flood mitigation storage areas and highway drainage attenuation storage ponds. The new design solution with regards to the flood mitigation storage areas has been informed through hydraulic modelling of the watercourses and includes associated proposed drainage ditch works and culverted watercourse proposals that cross the B1023 near Inworth.

3.1.2 The new design proposal is shown on Sheet 14 of 21 and Sheet 20 of 21 of Drainage and Surface Water Plans which are enclosed within consultation Map Book 4. Plate 3.1 and Plate 3.2 present schematic comparisons for the new design solution of the highway drainage and flood risk mitigation measures to those submitted in August 2022. Table 3.1 and Table 3.2 further summarise the key design changes for the new design in comparison to the design submitted in August 2022. Regarding the culverted watercourses associated with the proposed flood mitigation storage areas, Table A.3 in Appendix A presents a summary of the affected existing culvert locations including the new culvert requirements. The culverts schedule provided in Table A.3 in Appendix A details those culverts being retained, those that require extension where road widening is proposed and the new culverts required.

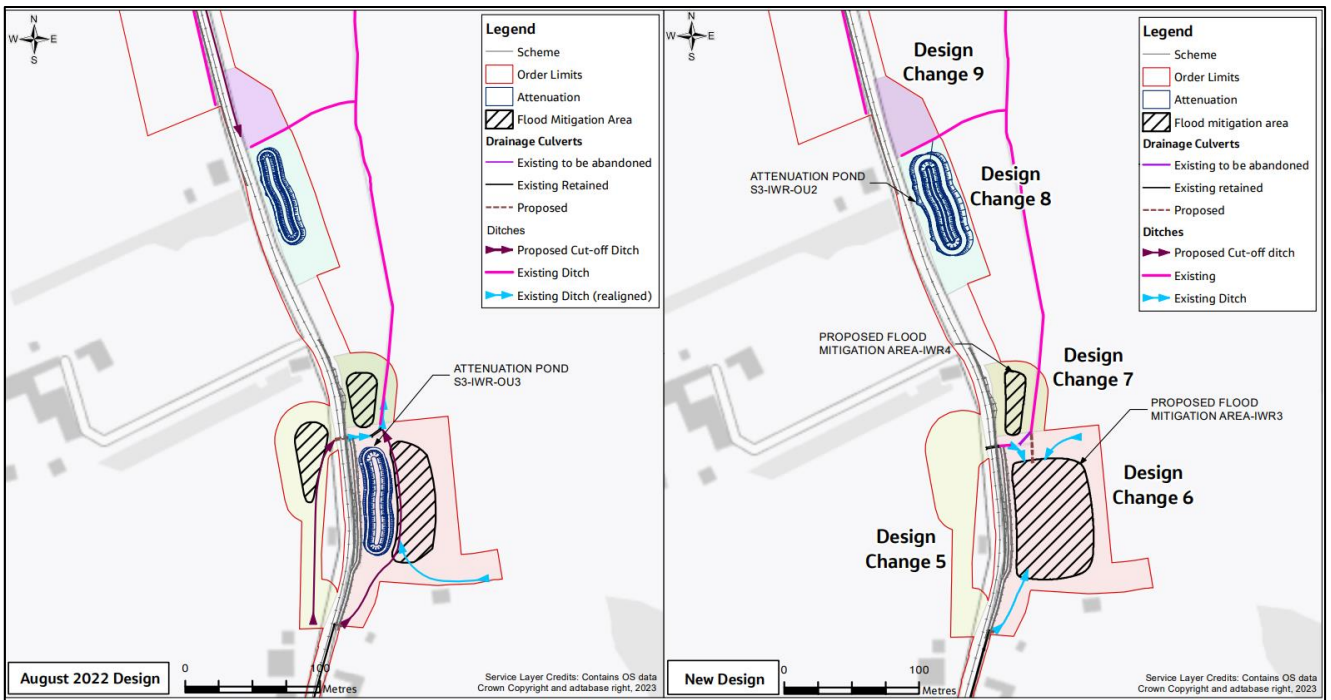
**Plate 3.1 New design proposals in comparison with design submitted in August 2022 in the vicinity of the B1023, near Inworth (Cluster Area 1)**



**Table 3.1 Summary of Design Changes - Drainage and Flood Mitigation Measures in the vicinity of the B1023 near Inworth (Cluster Area 1)**

Landtake Area Reference from Plate 3.1	New Design Solution
Design Change 1	<p><b>Attenuation Pond S3-IWR-OU7 has been removed.</b> There are no highway widening works within the catchment S3-IWR-OU7 boundary. Hydraulic checks indicate minor increase in flows due to an increase in rainfall values for climate change allowance which will be manageable through localised upgrades to drainage collection features.</p> <p>The design submitted in August 2022 included a flood mitigation storage area that would have required excavation over the gas main, the location of which was unknown at DCO Stage design. New design has taken this constraint into account and developed the solution through hydraulic modelling that confirmed <b>removal of flood mitigation measures in this area.</b></p>
Design Change 2	<p><b>New drainage ditches adjacent to the B1023 near Inworth</b> that were considered previously as part of flood risk mitigation <b>are not required.</b></p> <p>New design proposal has considered the constraint imposed by existing the HP gas main and been informed by hydraulic modelling. <b>New design (proposed flood mitigation -IWR1) provides a reduction in the flood mitigation storage area requirements.</b></p>
Design Change 3	<p><b>Attenuation Pond S3-IWR-OU5 has been retained.</b></p> <p><b>New design proposal (proposed flood mitigation – IWR2)</b> has been informed through hydraulic modelling and <b>provides reduction in the flood mitigation storage area requirements.</b></p>
Design Change 4	<p>New design has been developed through hydraulic modelling which has confirmed <b>removal of flood mitigation measures in this area.</b></p> <p><b>Proposed drainage ditch is retained</b> although required to move further away from the road and enlarged to capture the overland runoff from the catchment upstream which forms part of the overall solution for flood mitigation measures in this area.</p>

**Plate 3.2 New design proposals in comparison with the design submitted in August 2022 in the vicinity of the B1023 near Inworth (Cluster Area 2)**



**Table 3.2 Summary of Design Changes - Drainage and Flood Mitigation Measures in the vicinity of the B1023 near Inworth (Cluster Area 2)**

Landtake Area Reference from Plate 3.2	New Design Solution
Design Change 5	<p><b>New drainage ditch and flood mitigation storage area</b> adjacent to the B1023, near Inworth, that were considered for the design submitted at DCO <b>are not required</b>. Existing field drains/ditches found in the location of the new drainage ditch and will be retained.</p>
Design Change 6	<p>A new design solution has been developed to optimise the combined design solutions that would work for the mitigation required for the highway drainage (attenuation storage) and for the flood risk mitigation storage. <b>Attenuation Pond S3-IWR-OU3 has been removed</b> and the highway drainage catchment is now diverted to Attenuation Pond S3-IWR-OU2.</p> <p><b>Flood mitigation storage area (proposed flood mitigation area – IWR3)</b> has been informed through hydraulic modelling and has <b>increased in area (i.e. in comparison to the design submitted in August 2022 but is still within the Order Limits)</b>.</p>

Landtake Area Reference from Plate 3.2	New Design Solution
Design Change 7	<b>Flood mitigation storage area (proposed flood mitigation area – IWR4)</b> is proposed to be retained. Minor adjustments will be required to minimise the impact to the existing foul sewer in the area.
Design Change 8	<b>Attenuation Pond S3-IWR-OU2 is retained.</b> Note there has been an increase in the attenuation storage volume for Attenuation Pond S3-IWR-OU2 ( <b>i.e. in comparison to the design submitted in August 2022 but is still within Order Limits</b> ) as a result of the additional highway drainage catchment draining to this attenuation storage pond which was previously associated to Attenuation Pond S3-IWR-OU3 (i.e. Design Change 6). Attenuation Pond S3-IWR-OU2 has been adjusted locally to minimise the impact on the existing foul sewer located in this area.
Design Change 9	This area is considered as potential attenuation for the highway drainage for Catchment S3-IWR-OU1 that will be reduced in size as this catchment now drains through proposed Catchment S3-OU8B+OU8D. Refer to consultation Map Book 4, Sheet 20 of 21 of Drainage and Surface Water Plan for the revised catchments for the proposed S3-OU8B + OU8D catchments that includes the diverted existing S3-IWR-OU1 catchment.

- 3.1.3 In addition to the changes summarised above for the B1023, near Inworth, it is noted that the proposed highway design change at the B1023 roundabout includes the removal of a segregated left turn lane, which will result in a small reduction in paved area associated with the proposed S3-OU8B+OU8D catchments. However, as described in Design Change 9 in Table 3.2, the reduction in paved area catchment will be adjusted against the existing S3-IWR-OU1 catchment, which is proposed to be drained through the proposed S3-OU8B + OU8D catchment. This results in a small increase to the paved area and the associated attenuation storage volumes for Attenuation Ponds S3-OU8B and S3-OU8D in comparison to the design submitted in August 2022. It is noted that this small increase in the attenuation storage volume will not have an impact on the proposed attenuation storage ponds footprint reported as part of the highway drainage design in August 2022. This is because these proposed attenuation storage ponds were found to have adequate attenuation storage capacity following the optimisation of the attenuation pond base invert level / side slopes geometry and the surrounding natural terrain (i.e. steep terrain and / or high ground).

## 4 Impacts

### 4.1 Land take

4.1.1 The changes identified have resulted in changes to the proposed flood mitigation areas and highway drainage for the B1023. The new design removes new infrastructure from the exclusion zone of a gas pipeline and results in reduction in earthworks required for flood mitigation works. Several flood mitigation areas previously identified as being required are no longer necessary. New design provides reduction in the number of drainage attenuation ponds. As such it there will be a reduction in the area of land required permanently of approximately 34,098m<sup>2</sup>.

### 4.2 Access Arrangement

#### Maintenance access

4.2.1 The maintenance access tracks to the attenuation ponds and flood mitigation areas in the vicinity of the B1023 have been reviewed and amended to reflect the new design.

4.2.2 The following maintenance access tracks have been added or modified:

- 20/C - modified to include turning head for access to attenuation pond S3-IWR-OU5 and flood mitigation area IWR2
- 20/L - new track added to maintain flood mitigation area IWR1
- 20/M - new track added to maintain attenuation pond S3-IWR-OU2

#### Private means of access

4.2.3 The Private Means of Access provisions have also been reviewed to ensure that access is maintained to land that is adjacent to the Order Limits. As some land, particularly towards the south of the B1023, is no longer subject to powers of compulsory acquisition, provision for Private Means of Access can be reduced and in some cases is no longer required.

4.2.4 The following Private Means of Access tracks have been modified or removed following the revision of the land requirements:

- 20/C - modified to include turning head to access attenuation pond. Access to land outside of Order Limits to be maintained.
- 20/D - shortened to 3m, access from the B1023 to highway boundary only required
- 20/E - shortened to 3m, access from the B1023 to highway boundary only required
- 20/H – modified to include turning head to access attenuation pond. Access to land outside of Order Limits to be maintained.
- 20/J - no longer required as land is no longer subject to powers of compulsory acquisition

- 20/K - renumbered to avoid duplicate

4.2.5 The Streets, Rights of Way and Access plans have been updated to reflect the changes to the Private Means of Access and Maintenance Access tracks. (Map Book 4)

## 4.3 Construction

4.3.1 The removal of a number of attenuation ponds and flood mitigation storage areas will reduce the overall earthworks movement volumes. This will reduce the number of HGV movements associated with construction of these elements.

4.3.2 The proposed scheme construction programme and associated road closures required along the B1023 are highly unlikely to change due to the extent of the improvements to the existing drainage network, which are critical activities for that area.

## 4.4 Environment

4.4.1 The below sections describe the predicted environmental impacts of the new design of attenuation ponds and flood mitigation areas along the B1023, with reference to the conclusions in the assessment chapters of the Environmental Statement submitted as part of the DCO application (chapters 6 to 16 of the Environmental Statement, DCO examination library reference [APP-073 to APP-083]).

4.4.2 Each section addresses the change in potential impacts, change in proposed mitigation measures, and change to the assessment of likely significant effects as a result of the new design.

### Chapter 6: Air quality

#### Potential impacts

4.4.3 The air quality assessment undertaken for the Environmental Statement is based on modelling impacts to a set of predefined human health, ecological and pollution climate mapping (PCM) receptors (see Environmental Statement Appendix 6.5: Air quality modelling results [APP-104]). The reduction of land take along the B1023 has no material effect on the location of receptors, nor does it affect traffic forecasts in the opening year 2027. As the operational traffic remains unchanged from what was assessed in the Environmental Statement, and the receptors are unaffected, then the potential impacts would remain as reported in Environmental Statement Chapter 6: Air quality, Section 6.9 [APP-073].

4.4.4 The construction traffic for the proposed scheme is constrained to the A12 corridor, as a result subsequent emissions from construction traffic would not impact sensitive receptors on the B1023.

4.4.5 Potential impacts from dust during construction would not change.

#### Design, mitigation and enhancement measures

4.4.6 No additional mitigation measures, beyond standard mitigation for dust management, have been proposed on the basis that there would be no likely



significant air quality effects, in accordance with the Design Manual for Roads and Bridges (DMRB) LA 105 (see Chapter 6: Air quality, paragraph 6.10.6 [APP-073]). The land take reduction along the B1023 has no material effect on this outcome, and therefore no change to mitigation is required.

#### **Assessment of likely significant effects**

- 4.4.7 As the potential impacts would not change due to the reduction in land take along the B1023, there would be no change to the ES predictions of likely significant effects for human health, ecological, or PCM receptors (see Environmental Statement Chapter 6: Air quality, Section 6.11 [APP-073]).

### **Chapter 7: Cultural heritage**

#### **Potential impacts**

- 4.4.8 The impacts on cultural heritage assets that would be caused by the proposed scheme along the B1023 are considered within the assessment of effects presented in Environmental Statement Chapter 7: Cultural heritage [APP-074] and Appendix 7.9: Cultural heritage impact assessment summary tables [APP-117].
- 4.4.9 The removal or reduction in size of some proposed flood mitigation areas and attenuation ponds would reduce the duration and scale of impacts during construction on the settings of the grade I listed Church of All Saints, Inworth (Asset 708) and four grade II listed buildings: Inworth Hall (Asset 701), Gates and Gate Piers to Inworth Hall (Asset 712), Thatched Cottage (Asset 715), and Harborough Cottage (Asset 717). However, taken in the context of the impact on their settings from the construction of proposed attenuation ponds and changes to the alignment of the B1023, the impacts would not change sufficiently to reduce the significance of effect predicted in Environmental Statement Chapter 7: Cultural heritage [APP-074].
- 4.4.10 The removal or reduction in size of some proposed flood mitigation areas and attenuation ponds would reduce the duration and scale of impacts during construction on two non-designated historic landscape types (HLT): Settlement (HLT 1), and Modern Agriculture (HLT 14). This would be achieved through the retention of field boundaries, particularly the field south of Church of All Saints, Inworth (Asset 708). However, in the context of the overall proposed scheme the impacts on HLT 1 and HLT 14 would not change sufficiently to reduce the significance of effect assessed in Environmental Statement Chapter 7: Cultural heritage [APP-074].

#### **Design, mitigation and enhancement measures**

- 4.4.11 There would be no change to the measures proposed to mitigate impacts on the setting of designated and non-designated built heritage and historic landscape assets as a result of the proposed changes.
- 4.4.12 Measures were included in Environmental Statement Appendix 7.10: Archaeological mitigation strategy [APP-118] to evaluate the proposed flood mitigation areas for the presence of unknown archaeological remains through trial trenching. The scale of this requirement would be reduced to reflect the revised extent of the flood mitigation areas, but would otherwise be unchanged,

and would be secured through Commitment CH2 of the Register of Environmental Actions and Commitments [APP-185]. The Archaeological Mitigation Strategy will be updated to reflect this change, along with other changes that have resulted from ongoing engagement with Historic England and the county/local authority archaeology officers.

### **Assessment of likely significant effects**

- 4.4.13 Taken in the context of other impacts in this area, the assessment of the significance of effects on grade I listed Church of All Saints, Inworth (Asset 708), and grade II listed Inworth Hall (Asset 701), Gates and Gate Piers to Inworth Hall (Asset 712), Thatched Cottage (Asset 715), and Harborough Cottage (Asset 717), and non-designated HLT 1 and HLT 14 would be unchanged.

## **Chapter 8: Landscape and visual**

### **Potential impacts**

- 4.4.14 The landscape effects that would be caused by the proposed scheme at the B1023 are considered within the assessment of effects on local landscape character area F1 Messing Wooded Farmland, presented within Environmental Statement Appendix 8.2: Landscape effects schedule [APP-120]. The localised landscape impacts along the B1023 would be slightly reduced when considering the new design, because the attenuation ponds and flood mitigation areas would be less extensive which subsequently results in reduced loss of existing vegetation. However, the changes would be localised, and the assessment of impacts on F1 Messing Wooded Farmland within the Environmental Statement considers the full extent of the proposed scheme where it falls within F1 Messing Wooded Farmland, including proposals at junction 24 and along the mainline, as well as the proposals along the B1023. As such, the overall conclusions on landscape impacts reported within Environmental Statement Chapter 8: Landscape and visual [APP-075] and Appendix 8.2: Landscape effects schedule [APP-120] would not change as a result of the new design.
- 4.4.15 Visual effects have been assessed through the application of representative viewpoints located at publicly accessible viewpoints, a proportionate approach which is supported by the Guidelines for Landscape and Visual Impact Assessment, Third Edition (GLVIA3) and DMRB LA 107 Landscape and Visual Effects, Revision 2. There are no representative viewpoints that would be affected by the new design at the B1023. Therefore, the visual impacts assessed within Chapter 8: Landscape and visual [APP-075] and Appendix 8.3 Visual effects schedule [APP-121] would not change as a result of the new design.

### **Design, mitigation and enhancement measures**

- 4.4.16 The new design affects the landscape mitigation presented on sheet 20 of the Environmental Masterplan, part 3 [APP-088]. Proposed mitigation planting has been revised to reflect the new layout. The revisions comprise minor adjustments to the proposed mitigation, and do not materially affect the mitigation that would be delivered. The updated sheet of the Environmental

Masterplan showing the revised planting forms part of the Consultation Materials (Map Book 4).

### **Assessment of likely significant effects**

- 4.4.17 Consistent with the explanation presented above that the new design would not affect the landscape and visual impacts reported within the Environmental Statement, the landscape and visual effects reported within Chapter 8: Landscape and visual [APP-075], Appendix 8.2: Landscape effects schedule [APP-120] and Appendix 8.3: Visual effects schedule [APP-121] would not change as a result of the new design.

## **Chapter 9: Biodiversity**

### **Potential impacts**

- 4.4.18 The impacts on biodiversity resulting from the proposed scheme along the B1023 are considered within the assessment of effects presented in Environmental Statement Chapter 9: Biodiversity [APP-076] and the Supplementary Bat Survey Report [AS-032]. Biodiversity receptors of particular relevance along or in close proximity to the B1023 include Perry's Wood ancient woodland and Local Wildlife Site (LWS), Inworth Wood LWS, badger (one badger sett is located within 100m of the Order Limits), bats (four trees with low to moderate suitability for roosting bats are located within the Order Limits) and great crested newt (GCN) (one confirmed GCN pond - Pond 40 - is located within 250m of the Order Limits).
- 4.4.19 The removal or reduction in size of some proposed flood mitigation areas and attenuation ponds would not result in any new impacts on Perry's Wood ancient woodland and LWS, Inworth Wood LWS, badger, bats or GCN. The reduced extent of works would increase the intervening distance between construction activities and Inworth Wood LWS, and sensitive features for badger and GCN, particularly along the eastern edge of the B1023 (although no significant effects are predicted on these receptors in this location and therefore the level of impact would remain not significant). Hedgerow loss would be slightly reduced when considering the new design, because the attenuation ponds and flood mitigation areas would be less extensive which subsequently results in reduced loss of existing vegetation. There would therefore be no change to the conclusions presented for these receptors in Chapter 9: Biodiversity [APP-076].
- 4.4.20 The removal or reduction in size of some proposed flood mitigation areas and attenuation ponds would result in revisions to the landscaping proposals on sheet 20 of the Environmental Masterplan, part 3 [APP-088]. This would result in a minor reduction in the provision of associated grassland planting. However, there would be no change to planting of hedgerows with intermittent trees or individual trees due to the new design. The overall conclusions on biodiversity impacts reported within Chapter 9: Biodiversity [APP-076] would not change as a result of the new design.

### **Design, mitigation and enhancement measures**

- 4.4.21 The potential impacts would not change owing to the reduction in land take along the B1023, therefore no additional mitigation is required.

- 4.4.22 The new design affects the landscaping proposals through a reduction in the provision of grassland planting presented on sheet 20 of the Environmental Masterplan, part 3 [APP-088]. Proposed landscaping has been revised to reflect the new layout.

**Assessment of likely significant effects**

- 4.4.23 As the potential impacts would not change owing to the reduction in land take along the B1023, there would be no change to the significant effects reported within Section 9.11 of Chapter 9: Biodiversity [APP-076].

**Chapter 10: Geology and soils**

**Potential impacts**

- 4.4.24 The new junction design slightly reduces the agricultural land take required by the proposed scheme.
- 4.4.25 There are no land quality constraints or geological receptors in this location, so the new design does not result in any changes to the potential impacts reported in Section 10.9 of Environmental Statement Chapter 10: Geology and soils [APP-077].

**Design, mitigation and enhancement measures**

- 4.4.26 The new design does not necessitate any changes to be made to the design, mitigation and enhancement measures reported in Section 10.10 of Chapter 10: Geology and soils [APP-077]. No specific mitigation measures were identified for this aspect along the B1023, beyond standard measures for managing soil during construction, and therefore no change to this is required with the new design.

**Assessment of likely significant effects**

- 4.4.27 While the new design is likely to result in a small reduction in overall agricultural land loss/disturbance, this reduction is considered insignificant compared to the overall agricultural land loss/disturbance for the whole proposed scheme, and therefore there is no change to the significance of effects reported in Section 10.11 of Chapter 10: Geology and soils [APP-077].

**Chapter 11: Material assets and waste**

**Potential impacts**

- 4.4.28 The new design does not result in any changes to the potential impacts reported in Section 11.9 of Environmental Statement Chapter 11: Material assets and waste [APP-078]. This aspect does not assess the impacts associated with specific design elements at a local level, and instead focuses on assessing the impacts of materials consumption, minerals sterilisation and waste disposal in absolute terms.

**Design, mitigation and enhancement measures**

- 4.4.29 The new design does not necessitate any changes to be made to the design, mitigation and enhancement measures reported in Section 11.10 of Chapter 11: Material assets and waste [APP-078]. No additional mitigation measures were

identified for this aspect in relation to the B1023, and therefore no change to this is required with the new design.

#### **Assessment of likely significant effects**

- 4.4.30 While the new design is likely to result in negligible, yet indeterminate, changes to the total materials consumption, minerals sterilisation and waste disposal reported in Section 11.11 of Chapter 11: Material assets and waste [APP-078], any changes are considered insignificant in the context of the entire proposed scheme.
- 4.4.31 The changes from the new design would not be at a level that would generate any new or different likely significant effects to those already reported for the proposed scheme, and there is therefore no change to the reported residual significance of effects for the material assets or waste matters of this aspect.

### **Chapter 12: Noise and vibration**

#### **Potential impacts**

- 4.4.32 The closest construction receptor to the proposed works is R28, which is representative of receptors along the B1023 (this is shown on sheet 3 of Environmental Statement Figure 12.3 [APP-230]). During vegetation clearance, the noise level was predicted to be above the significant observed adverse effect level (SOAEL), indicating the potential for likely significant adverse effects if the temporal threshold is exceeded, as defined in paragraph 12.5.27 of Environmental Statement Chapter 12: Noise and vibration [APP-079]. This potential impact is identified in paragraph 12.9.18 of Chapter 12: Noise and vibration [APP-079]. The works for the revised drainage and flood mitigation design would still require vegetation clearance, albeit for a reduced number of ponds and flood mitigation areas, and the predicted noise level would be above the SOAEL, therefore the potential impact remains.
- 4.4.33 The operation of the drainage and flood mitigation design would not generate any noticeable levels of noise and so impacts were not calculated within Chapter 12: Noise and vibration [APP-079]. This would be the same for the new design.

#### **Design, mitigation and enhancement measures**

- 4.4.34 No specific construction mitigation measures beyond standard mitigation measures were identified for the works along the B1023, and no change to this is required with the new design.
- 4.4.35 During operation there were no mitigation measures identified as there was no potential impact. There is no change to the potential impact with the new design, and therefore no change to operational mitigation is required.

#### **Assessment of likely significant effects**

- 4.4.36 During construction there were no significant adverse effects identified from the works along the B1023, as the duration of the vegetation clearance works did not exceed the temporal threshold defined in paragraph 12.5.27 of Chapter 12: Noise and vibration [APP-079]. The new design would not increase the timeframe the works would be undertaken over, so there would be no significant

adverse effect from the revised works, and hence the conclusions of the Environmental Statement do not change.

- 4.4.37 The operation of the drainage and flood mitigation design do not generate any noticeable levels of noise and so effects were not predicted within Chapter 12: Noise and vibration [APP-079]. This would be the same for the new design, and so the conclusions of the Environmental Statement do not change.

## **Chapter 13: Population and human health**

### **Potential impacts**

- 4.4.38 The new design would have a reduced impact on agricultural landholdings due to the reduced land take for the attenuation ponds and flood mitigation areas. It would have no change in impacts on private property and housing, community land and assets or development land and businesses as these types of land use would not be directly affected by the new design in this location.
- 4.4.39 There would be no change in impact from that previously assessed for walkers, cyclists and horse riders as the potential impact on footpath 145\_15 has been identified and assessed in the Environmental Statement (Table A.16 in Appendix 13.3: Land Use and Accessibility Assessment Tables [APP-155]), and there would be no change to this impact from the new design.
- 4.4.40 No change in impact on human health is anticipated from that assessed within the Environmental Statement on the basis that there is no change in health determinants impacted on from the new design.

### **Design, mitigation and enhancement measures**

- 4.4.41 The new design would not affect the mitigation outlined in Section 13.9 of Environmental Statement Chapter 13: Population and human health [APP-080] regarding impacts on agricultural landholdings, as agricultural landholdings would still be affected albeit to a lesser degree. The proposed mitigation therefore remains appropriate.
- 4.4.42 There would be no change in mitigation for other matters within Chapter 13: Population and human health [APP-080], as there would be no change to the potential impacts.

### **Assessment of likely significant effects**

- 4.4.43 The reduced impact on arable land use would not materially change the assessment of likely significant effects. While there would be reduced land-take from fields owned by two landholders, which are currently used for cereal production, this would not be of a scale to reduce the overall effect on agricultural landholdings concluded in section 13.20 of Chapter 13: Population and human health [APP-080], where the loss of agricultural land is assessed as large adverse. This is on the basis that the new design changes would only affect approximately 1% of the agricultural land previously identified as being impacted on by the proposed scheme.
- 4.4.44 There would be no change in effects for other matters within Chapter 13: Population and human health [APP-080], as there would be no change to the potential impacts.

## Chapter 14: Road drainage and the water environment

### Potential impacts

- 4.4.45 The Environmental Statement reported operational surface water quality assessment of seven (IWR-1 to IWR-7) proposed outfalls serving the proposed scheme on the B1023.
- 4.4.46 The seven outfalls were assessed for surface water quality impacts and groundwater quality impacts. The watercourses that are proposed to receive discharges from the B1023 outfalls (Watercourses 34 and 34c) were assigned the minimum Q95 for use within the surface water quality assessments as a conservative approach. As a consequence, these are considered to be 'low-flow' watercourses that present 'dry' conditions and act like a soakaway, therefore, overall impact assessment was based upon a groundwater quality assessment. The design changes to the B1023 do not propose the outfalls discharging to non 'low-flow' watercourses and as such, the overall method of assessment does not change.
- 4.4.47 The surface water assessment results, although not used to inform overall significance of effect, were presented in the Environmental Statement in Appendix 14.1: Water Quality Assessment Report [APP-158]. The post-mitigation Highways England Water Risk Assessment Tool (HEWRAT) results (Step 3) presented in Appendix 14.1 concluded a 'pass' for environmental quality standards (EQS) compliance and soluble pollutants. The assessment for the B1023 was assessed cumulatively excluding sediment-bound pollutants.
- 4.4.48 HEWRAT assessments have been undertaken to reflect the new design. The outfalls for the B1023 have been assessed both individually and cumulatively (excluding sediment-bound pollutants for outfalls more than 100m apart) at Step 3 – post-mitigation. These results show a 'pass' for EQS compliance and soluble (and sediment-bound, where applicable) pollutants. Therefore, there is no change in terms of surface water impacts, as shown in Table 4.1.

**Table 4.1 HEWRAT Surface Water Quality Assessments post-mitigation (Step 3) results**

Outfall Reference	Receiving Watercourse Name/ number	HEWRAT Routine Runoff Assessment (Method A)						
		Soluble Cu. No of exceedances /year		Soluble Zn. No of exceedances /year		AA-EQS Compliance (Cu ug/l)	AA-EQS Compliance (Zn ug/l)	Sediment Bound Pollutants (Pass/Fail)
		RST24	RST6	RST24	RST6			
<b>Post - Mitigation (Step 3)</b>								
<b>S3 - OU08B&amp;8D (IWR1)</b>	Unnamed Ditch	0.00	0.00	0.00	0.00	0.13	0.30	Pass (Alert)
<b>IWR2</b>	Ordinary Watercourse 34	0.00	0.00	0.00	0.00	0.12	0.30	Pass
<b>IWR5</b>	Ordinary Watercourse 34C	0.00	0.00	0.00	0.00	0.01	0.04	Pass

Outfall Reference	Receiving Watercourse Name/ number	HEWRAT Routine Runoff Assessment (Method A)						
		Soluble Cu. No of exceedances /year		Soluble Zn. No of exceedances /year		AA-EQS Compliance (Cu ug/l)	AA-EQS Compliance (Zn ug/l)	Sediment Bound Pollutants (Pass/Fail)
		RST24	RST6	RST24	RST6			
<b>Post - Mitigation (Step 3)</b>								
IWR5A	Ordinary Watercourse 34C	0.00	0.00	0.00	0.00	0.04	0.09	Pass
IWR6	Ordinary Watercourse 34C	0.00	0.00	0.00	0.00	0.05	0.10	Pass
IWR7	Ordinary Watercourse 34C	0.00	0.00	0.00	0.00	0.03	0.07	Pass
<b>Cumulative Assessment (Including IWR2 to IWR7)</b>	Ordinary Watercourse 34/34C	0.20	0.00	0.00	0.00	0.28	0.71	n/a

4.4.49 The new design would result in a reduction in flood risk to the B1023 from the baseline scenario, with areas of very large beneficial impact. The beneficial impact would be of the same magnitude as that described in Chapter 14: Road drainage and the water environment.

4.4.50 The new design would not result in any changes to watercourses from the baseline scenario, although flow levels would be locally raised within the watercourse in some areas.

#### **Design, mitigation and enhancement measures**

4.4.51 One of the primary reasons for the change in design is a change in the flood risk mitigation for the proposed scheme. This has been discussed in Section 3 of this report and is not described further here.

4.4.52 There is no change in potential water quality, groundwater, or hydromorphology impacts along the B1023 from the new design. No change to the design mitigation or enhancement measures described in Section 14.10 of Chapter 14: Road drainage and the water environment [APP-081] are therefore required.

#### **Assessment of likely significant effects**

4.4.53 The assessment of significant effect upon water quality for the B1023 outfalls is determined by a groundwater assessment based on the low flows in the receiving watercourses. As the location of the proposed mitigation has not changed, the conclusion of the cumulative impact assessment of risk to groundwater at this location is low as shown in Appendix H of the Water Quality Assessment Report [APP-158]. There is no change in the significance of effects which are assessed as neutral as shown in Appendix F of the Water Quality Assessment Report [APP-158].



## Chapter 15: Climate

### Potential impacts

- 4.4.54 The new drainage and flood mitigation design would not substantially influence the quantities of materials required to construct the proposed scheme, nor affect traffic flows with the proposed scheme in place. As such, the proposed changes would not have a material impact on the magnitude of estimated changes in greenhouse gas (GHG) emissions associated with the proposed scheme.
- 4.4.55 Furthermore, the proposed changes would not alter the vulnerability of the proposed scheme to future changes in climate.

### Design, mitigation and enhancement measures

- 4.4.56 The mitigation measures presented in Environmental Statement Chapter 15: Climate [APP-082] are considered to remain valid, and therefore no changes to the measures presented in the Environmental Statement are required.

### Assessment of likely significant effects

- 4.4.57 As neither emissions of GHGs nor the vulnerability of the proposed scheme to climate change are considered likely to be affected by the proposed changes, then the conclusions set out in Chapter 15: Climate [APP-082] remain unchanged.

## Chapter 16: Cumulative effects assessment

### Potential impacts

- 4.4.58 In accordance with Environmental Statement Chapter 16: Cumulative effects assessment [APP-083], material assets and waste and climate have been scoped out of the assessment of cumulative effects.
- 4.4.59 The remaining individual topic chapters above have been reviewed in order to identify any changes to individual topic effects before then considering how any such changes may contribute to changes in cumulative effects. The findings of this review are shown in Table 4.2.

**Table 4.2 Cumulative effects**

Topic	Potential for cumulative effects
Air quality	There would be no change to the significant effects reported in Environmental Statement Chapter 6: Air quality [APP-073]. Therefore, there would be no change to the cumulative effects reported in Environmental Statement Chapter 16: Cumulative effects assessment [APP-083].
Cultural heritage	There would be no change to the significant effects reported in Environmental Statement Chapter 7: Cultural heritage [APP-074]. Therefore, there would be no change to the cumulative effects reported in Environmental Statement Chapter 16: Cumulative effects assessment [APP-083].

Topic	Potential for cumulative effects
Landscape and visual	There would be no change to the significant effects reported in Environmental Statement Chapter 8: Landscape and visual [APP-075]. Therefore, there would be no change to the cumulative effects reported in Environmental Statement Chapter 16: Cumulative effects assessment [APP-083].
Biodiversity	There would be no change to the significant effects reported in Environmental Statement Chapter 9: Biodiversity [APP-076]. Therefore, there would be no change to the cumulative effects reported in Environmental Statement Chapter 16: Cumulative effects assessment [APP-083].
Geology and soils	There would be no change to the likely significant effects reported in Chapter 10: Geology and soils [APP-077]. Therefore, there would be no change to the cumulative effects reported in Environmental Statement Chapter 16: Cumulative effects assessment [APP-083].
Noise and vibration	There would be no change to the likely significant effects reported in Chapter 12: Noise and vibration [APP-079]. Therefore, there would be no change to the cumulative effects reported in Environmental Statement Chapter 16: Cumulative effects assessment [APP-083].
Population and human health	There would be no change to the significant effects reported in Environmental Statement Chapter 13: Population and human health [APP-080]. Therefore, there would be no change to the cumulative effects reported in Environmental Statement Chapter 16: Cumulative effects assessment [APP-083].
Road drainage and the water environment	There would be no change to the significant effects reported in Environmental Statement Chapter 14: Road drainage and the water environment [APP-081]. Therefore, there would be no change to the cumulative effects reported in Environmental Statement Chapter 16: Cumulative effects assessment [APP-083].

### Design, mitigation and enhancement measures

- 4.4.60 No new or different cumulative effects are predicted from the new design, hence no design, mitigation and enhancement measures are required.

### Assessment of likely significant effects

- 4.4.61 There is no change to the reported assessment of cumulative effects in Chapter 16: Cumulative effects assessment [APP-083] due to the new design.

### Overall environment conclusion

- 4.4.62 Impacts along the B1023 would decrease as the number of attenuation ponds and flood mitigation areas decrease, resulting in reduced land take and vegetation loss. The reduction in impacts would not be on a scale or magnitude to change the significant effects reported in the Environmental Statement. There are therefore no new or different likely significant effects arising from the new design.

## **5 Conclusion**

- 5.1.1 The change reported on above has resulted in a reduction in the permanent land take of approximately 34,098m<sup>2</sup> whilst the effects of construction and operation of the scheme would remain consistent with the findings presented within the relevant chapters of the Environmental Statement.

## **Appendix A New design outputs summary for the proposed highway drainage**

**Table A.1 Paved and Permeable Catchment Areas Summary**

Proposed catchment	Existing paved area <sup>1</sup>	New paved area	Total proposed paved area <sup>2</sup>	Total proposed permeable area <sup>3</sup>	Catchment-specific comments
	(ha)	(ha)	(ha)	(ha)	
S3-IWR-OU2	0.414 (0.157)	0.055	0.469	0.028	<p>Minor highway improvement works to the existing B1023 in addition to the proposed offline walking, cycling and horse-riding (WCH) route access provision.</p> <p>The existing paved area (0.414ha) associated with the existing the B1023 portion, includes the existing retained paved area of 0.157ha within S3-IWR-OU2 catchment, the existing paved area (0.088ha) associated with existing S3-IWR-OU3 catchment and the existing paved area (0.169ha) associated with the existing S3-IWR-OU4 catchment that will be contained within the proposed S3-IWR-OU2 catchment boundary</p>
S3-IWR-OU5	0.092 (0.046)	0.002	0.048	0	<p>Minor highway improvement works to the existing B1023</p> <p>The existing paved area (0.092ha) is associated with the existing S3-IWR-OU5 catchment that has been divided up between the proposed S3-IWR-OU5 catchment and the proposed S3-IWR-OU5A catchment (i.e. 0.046ha will be retained within the proposed S3-IWR-OU5 catchment boundary while 0.046ha will be drained to the proposed S3-IWR-OU5A catchment boundary)</p>
S3-IWR-OU5A	0 (0.082)	0.005	0.087	0.092	<p>Minor highway improvement works to the existing B1023</p> <p>The existing paved area is associated with the existing S3-IWR-OU5 catchment portion (0.046ha) and the existing S3-IWR-OU6 catchment portion</p>

Proposed catchment	Existing paved area <sup>1</sup>	New paved area	Total proposed paved area <sup>2</sup>	Total proposed permeable area <sup>3</sup>	Catchment-specific comments
	(ha)	(ha)	(ha)	(ha)	
					(0.036ha) contained within the proposed S3-IWR-OU5A catchment boundary
S3-IWR-OU6	0.129 (0.093)	0	0.093	0	<p>No online highway widening works proposed within the proposed S3-IWR-OU6 catchment boundary</p> <p>The existing paved area (0.129ha) is associated with the existing S3-IWR-OU6 catchment that has been divided up between the proposed S3-IWR-OU5A catchment and the proposed S3-IWR-OU6 catchment (i.e. 0.093ha will be retained within the proposed S3-IWR-OU6 catchment boundary while 0.036ha will be drained to the proposed S3-IWR-OU5A catchment)</p>
S3-IWR-OU7	0.089	0	0.089	0	No online highway widening works proposed within the proposed S3-IWR-OU7 catchment boundary
S3-OU8B+8D	0 (0.127)	0.384	0.511	0.238	<p>The new Inworth Link Road portion and new B1023 Roundabout connecting the link road to the existing B1023. New paved area has been reduced from the design submitted at DCO due to a change in the highway design which removes the segregated left turn from the B1023 approaching the new B1023 Roundabout</p> <p>The existing paved area (0.127ha) is associated with the existing B1023 portion associated with the existing S3-IWR-OU1 catchment that will be drained to the proposed S3-OU8B+8D catchment. As a result, the total proposed paved area associated with the proposed S3-OU8B +8D catchment has been increased (0.105ha) compared</p>

Proposed catchment	Existing paved area <sup>1</sup>	New paved area	Total proposed paved area <sup>2</sup>	Total proposed permeable area <sup>3</sup>	Catchment-specific comments
	(ha)	(ha)	(ha)	(ha)	
					to that which was submitted at DCO (See Note 4)

**Notes:**

1. For some proposed catchments the retained existing paved area contained within the proposed catchment boundary differs to that in the existing site condition. This is due to the retained existing paved area’s adjustment to neighbouring catchments where required due to site constraints. The retained existing paved area within the proposed catchment boundary is presented in brackets in the ‘Existing paved area’ column where applicable and is included in the total proposed paved area summation.
2. The total proposed paved area is the sum of the existing paved area (adjusted existing paved area where applicable) to be retained and the additional new paved area which will form the proposed highway drainage catchment areas across the proposed scheme. The existing and additional new paved areas are illustrated on the Drainage and Surface Water Plan – Sheet 14 of 21 and Sheet 20 of 21, within consultation Map Book 4.
3. Permeable catchment areas include grassed verges, grassed roundabout centre islands, cut slopes, embankment slopes, etc. that drain into the proposed highway drainage systems.
4. It is noted that the small increase in paved area (0.105ha) will not have an impact on the proposed S3-OU8B and S3-OU8D catchment attenuation pond volumes and the associated footprint reported at DCO. This is because these attenuation ponds were found to have adequate attenuation storage capacity following the optimisation of the attenuation pond base invert level / side slopes geometry and the surrounding natural terrain (i.e. steep terrain and / or high ground).

**Table A.2 Discharge Rate and Attenuation Storage Volume Summary**

Proposed catchment	Receiving watercourse	Modelled peak discharge rates (l/s) <sup>1</sup>					Flow control type (diameter)	Attenuation storage type	Estimated attenuation storage volume <sup>3</sup> (m <sup>3</sup> )	Catchment specific comments
		Allowable discharge rates (A) <sup>2,4</sup>								
		Proposed discharge rates (P) <sup>2</sup>								
A / P	1yr	2yr	5yr	100yr						
S3-IWR-OU2	Existing drainage ditch (Ultimately Ordinary Watercourse 34)	A	31.0	29.5	38.8	78.8	Orifice plate (175mm) & Orifice Plate (300mm)	Attenuation pond	201	Minor highway improvement works on the B1023 which currently discharges to an existing drainage ditch. Therefore, brownfield discharge rates are applicable. A new outfall is required to an existing drainage ditch located adjacent to the B1023. The proposed S3-IWR-OU2 catchment also intercepts the flows from the existing S3-IWR-OU3 and S3-IWR-OU4 catchments. This is because attenuation pond provision is not feasible due to spatial constraints adjacent to the existing S3-IWR-OU3 and S3-IWR-OU4 catchments. See Note 4 and Note 5. Two orifice plate flow control devices are required and are to be set at different levels to ensure the proposed discharge rates meet the existing case allowable discharge rates
		P	24.0	27.2	31.6	67.6				



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Proposed catchment	Receiving watercourse	Modelled peak discharge rates (l/s) <sup>1</sup>					Flow control type (diameter)	Attenuation storage type	Estimated attenuation storage volume <sup>3</sup> (m <sup>3</sup> )	Catchment specific comments
		Allowable discharge rates (A) <sup>2,4</sup>								
		Proposed discharge rates (P) <sup>2</sup>								
A / P	1yr	2yr	5yr	100yr						
S3-IWR-OU5	Culverted Watercourse CL-IWR-4 (Ultimately Ordinary Watercourse 34)	A	18.4	17.6	23.6	53.7	Hydrobrake (107mm)	Attenuation pond	82	<p>Highway improvement works on the B1023 which currently discharges to an existing drainage ditch. Therefore, brownfield discharge rates are applicable</p> <p>A new outfall is required to culverted watercourse (Culvert CL-IWR-CL4) located adjacent to the B1023</p>

Proposed catchment	Receiving watercourse	Modelled peak discharge rates (l/s) <sup>1</sup>					Flow control type (diameter)	Attenuation storage type	Estimated attenuation storage volume <sup>3</sup> (m <sup>3</sup> )	Catchment specific comments
		Allowable discharge rates (A) <sup>2,4</sup>								
		Proposed discharge rates (P) <sup>2</sup>								
A / P	1yr	2yr	5yr	100yr						
		P	5	5	5	5				<p>Spatial constraints prevent attenuation pond provision for the adjacent proposed S3-IWR-OU5A catchment. Hence the mitigation attenuation storage is provided within the proposed S3-IWR-OU5 catchment attenuation pond</p> <p>A minimum practicable discharge rates of 5 l/s has been used (see the catchment specific comment for the proposed S3-IWR-OU5A catchment)</p>
S3-IWR-OU5A	Culverted Watercourse CL-IWR_4 (Ultimately Ordinary Watercourse 34)	A	See Comments				None. Unattenuated	None	-	<p>Brownfield discharge rates are applicable due to online highway widening works</p> <p>The existing case S3-IWR-OU5 catchment has been divided into the</p>

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Proposed catchment	Receiving watercourse	Modelled peak discharge rates (l/s) <sup>1</sup>					Flow control type (diameter)	Attenuation storage type	Estimated attenuation storage volume <sup>3</sup> (m <sup>3</sup> )	Catchment specific comments
		Allowable discharge rates (A) <sup>2,4</sup>								
		Proposed discharge rates (P) <sup>2</sup>								
A / P	1yr	2yr	5yr	100yr						
		P	11	10.0	16.0	43.8				proposed case S3-IWR-OU5 and S3-IWR-OU5A catchments  The existing S3-IWR-OU6 catchment allowable discharge rates are apportioned between the proposed S3-IWR-OU5 and S3-IWR-OU5A catchments. A new outfall to the culverted watercourse (Culvert CL-IWR-4) will be required

Proposed catchment	Receiving watercourse	Modelled peak discharge rates (l/s) <sup>1</sup>					Flow control type (diameter)	Attenuation storage type	Estimated attenuation storage volume <sup>3</sup> (m <sup>3</sup> )	Catchment specific comments
		Allowable discharge rates (A) <sup>2,4</sup>								
		A / P	1yr	2yr	5yr	100yr				
S3-IWR-OU6	Culverted Watercourse CL-IWR-9 (Ultimately Ordinary Watercourse 34)	A	24	22.8	30.7	64.9	None. Unattenuated	None	-	<p>Highway improvement works on the existing B1023 which currently discharges to an existing culvert, CL-IWR-9. Therefore, brownfield discharge rates are applicable</p> <p>A new outfall to existing culvert CL-IWR-CL9 will be required</p> <p>The proposed S3-IWR-OU6 catchment requires no attenuation storage given that the proposed catchment has been adjusted with the proposed S3-IWR-OU5 catchment and results in proposed discharge rates that are less than the existing case allowable discharge rates. This is achieved without the use of a formal means of attenuation storage</p>
		P	21.8	20.7	27.8	59.3				

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Proposed catchment	Receiving watercourse	Modelled peak discharge rates (l/s) <sup>1</sup>					Flow control type (diameter)	Attenuation storage type	Estimated attenuation storage volume <sup>3</sup> (m <sup>3</sup> )	Catchment specific comments
		Allowable discharge rates (A) <sup>2,4</sup>								
		A / P	1yr	2yr	5yr	100yr				
S3-IWR-OU7	Ordinary Watercourse 34C	A	16.3	15.5	20.8	42.7	None. Unattenuated	None	-	Existing catchment on the B1023 which currently discharges to an existing drainage ditch. Brownfield discharge rates are applicable. The existing outfall may need to be repositioned locally. Minor increase in the proposed case discharge rates has been adjusted by a reduction in the discharge rates for the proposed S3-IWR-OU5 catchment which ultimately discharges to the same receptor (Ordinary Watercourse 34)
		P	20.4	19.3	25.7	45.6				
Combined S3-IWR-OU5, OU5A, OU6 and OU7	Ordinary Watercourse 34	A	58.7	55.9	75.1	161.3	N/A	N/A	N/A	The combined proposed discharge rates from the proposed S3-IWR-OU5, S3-IWR-OU5A, S3-IWR-OU6 and S3-IWR-OU7 are less than the combined existing S3-IWR-OU5, S3-IWR-OU6 and S3-IWR-OU7 allowable discharge rates. This ensures there is no adverse flood risk impact, considering that these catchments have a common ultimate receptor in culverted Ordinary Watercourse 34
		P	58.2	55.0	74.5	153.7				

Proposed catchment	Receiving watercourse	Modelled peak discharge rates (l/s) <sup>1</sup> Allowable discharge rates (A) <sup>2,4</sup> Proposed discharge rates (P) <sup>2</sup>					Flow control type (diameter)	Attenuation storage type	Estimated attenuation storage volume <sup>3</sup> (m <sup>3</sup> )	Catchment specific comments
		A / P	1yr	2yr	5yr	100yr				

**Notes:**

1. FEH2013 rainfall data has been used in the hydraulic calculations for the modelled peak discharge rates. FEH2013 rainfall cannot be used for the assessment of the 1 in 1-year return period storm event. Therefore, FEH1999 rainfall data have been used for the assessment of the 1 in 1-year return period storm event. Section 4.6 of the Surface Water Drainage Strategy [APP-174] provides further details on the rainfall data inputs.
2. The existing case allowable discharge rates do not include a climate change allowance given that current climatic conditions are required to inform the discharge rates for the proposed highway drainage systems. The proposed case discharge rates include a climate change allowance as described in Section 4.4 of the Surface Water Drainage Strategy [APP-174].
3. The modelled proposed case attenuation storage volumes are determined for the 1 in 100-year return period storm event plus a climate change allowance.
4. The modelled proposed case attenuation storage volumes for attenuation pond S3-IWR-OU2 is based on existing case allowable discharge rates associated with the existing S3-IWR-OU2 catchment only. This does not take into account the existing case discharge rates associated with the existing S3-IWR-OU3 and S3-IWR-OU4 catchments which are part of the proposed S3-IWR-OU2 catchment and is considered as a conservative design approach for the estimation of the attenuation storage volumes and the associated landtake.
5. With regards to the proposed S3-IWR-OU2 catchment which includes the existing S3-IWR-OU3 and S3-IWR-OU4 catchments, it is currently assumed that a separate highway drainage system (i.e. the existing highway drainage network has connections to the existing culverted watercourse which are proposed to be abandoned) will be feasible to install within the road corridor for the section of road associated with the existing S3-IWR-OU3 and S3-IWR-OU4 catchments. This highway drainage proposal would need to be reviewed at the detailed design stage.

**Table A.3 Existing and Proposed Culverts Schedule for the B1023**

Culvert name <sup>1</sup>	National Grid Reference (NGR)	Existing culvert (retained/ extension/ abandoned) or Proposed Culvert	Culvert type	Culvert dimensions <sup>3</sup> (m)	Total culvert length (m)	Approx. length of proposed culvert extension (m)	Culvert crossing (watercourse / ditch)	Comments
CL-IWR-1A	TL88362 17267	Existing to be retained	Pipe	0.3	15	N/A	Ordinary Watercourse 34C	Existing culvert is not affected by the proposed highway improvement works
CL-IWR-2	TL88114 17692	Proposed	Pipe	0.3	25	N/A	Ordinary Watercourse 34C	New culvert located downstream of proposed flood mitigation storage area IWR1. The culvert size is determined through hydraulic modelling to restrict the flows from the upstream catchment as part of the flood mitigation proposals
CL-IWR-2A	TL88022 17625	Proposed	Pipe	1.2	5	N/A	Ordinary Watercourse 34C	New culvert required for draining the diverted ditch at an existing footpath
CL-IWR-4.1	TL88114 17692	Existing to be abandoned	Pipe	0.85	74	N/A	Ordinary Watercourse 34C	The existing culvert will be abandoned The existing watercourse upstream of this culvert will be diverted to the proposed flood mitigation storage area IWR2. The attenuated flows from the proposed mitigation storage area IWR2 will be drained through proposed culvert CL-IWR-4B

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Culvert name <sup>1</sup>	National Grid Reference (NGR)	Existing culvert (retained/ extension/ abandoned) or Proposed Culvert	Culvert type	Culvert dimensions <sup>3</sup> (m)	Total culvert length (m)	Approx. length of proposed culvert extension (m)	Culvert crossing (watercourse / ditch)	Comments
CL-IWR-9	TL88031 17749	Existing to be extended	Pipe	0.45	68	2.7	Ordinary Watercourse 34C	The existing culvert hydraulic capacity was found to be adequate. Proposed culvert length includes approximately 2.7m of culvert extension to account for the highway widening works. The culvert extension will retain the existing pipe culvert geometry and gradient
CL-IWR-4B	TL88052 17760	Proposed	Pipe	0.6	69	N/A	Ordinary Watercourse 34C	New culvert located downstream of proposed flood mitigation storage area IWR2. The culvert size is determined through hydraulic modelling to restrict the flows from the upstream catchment as part of the flood mitigation proposal. This culvert partially replaces about 25m of an existing 900mm diameter pipe culvert
CL-IWR-4	TL87982 17901	Existing to be retained	Pipe	0.9 1.0 0.65	25 (0.9m dia pipe) 158 (1.0m dia pipe) 14 (0.65m dia pipe)	N/A	Ordinary Watercourse 34C	A chamber exists along the existing culvert alignment where the pipe diameter changes from 900mm (upstream) to 1000mm and then to 650mm diameter (downstream). Hydraulic modelling undertaken has taken into account the existing culvert to be retained. The flood mitigation measures proposed upstream of Culvert CL-IWR-4B and downstream of CL-IWR-4A are also applicable to this culvert location



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Culvert name <sup>1</sup>	National Grid Reference (NGR)	Existing culvert (retained/ extension/ abandoned) or Proposed Culvert	Culvert type	Culvert dimensions <sup>3</sup> (m)	Total culvert length (m)	Approx. length of proposed culvert extension (m)	Culvert crossing (watercourse / ditch)	Comments
CL-IWR-4A	TL88012 18015	Proposed	Pipe	0.65	5	N/A	Ordinary Watercourse 34C	For sizing this new culvert, flow is taken from existing retained culvert CL-IWR4 as this culvert is located downstream of Culvert CL-IWR4. Mitigation measures proposed upstream of Culvert CL-IWR4 and Culvert CL-IWR-4B are also applicable to this culvert
CL-IWR-5	TL87996 17846	Existing to be extended	Pipe	0.6	23	12	Drainage culvert	The existing culvert hydraulic capacity was found to be adequate. The proposed culvert length includes approximately 12m of culvert extension to account for the highway widening works. The culvert extension will retain the existing pipe culvert geometry and gradient
CL-IWR-8	TL88046 18162	Existing to be abandoned	Pipe	0.5	9	N/A	Ordinary Watercourse 34	The existing culvert will be abandoned The existing watercourse upstream of this culvert will be diverted to proposed flood mitigation storage area IWR3. The attenuated flows from the proposed mitigation storage area IWR3 will be drained through proposed culvert CL-IWR-8A

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Culvert name <sup>1</sup>	National Grid Reference (NGR)	Existing culvert (retained/ extension/ abandoned) or Proposed Culvert	Culvert type	Culvert dimensions <sup>3</sup> (m)	Total culvert length (m)	Approx. length of proposed culvert extension (m)	Culvert crossing (watercourse / ditch)	Comments
CL-IWR-8A	TL88044 18160	Proposed	Pipe	0.6	21	N/A	Ordinary Watercourse 34	New culvert located downstream of proposed flood mitigation storage area IWR3. The culvert size is determined through hydraulic modelling to restrict the flows as part of the flood mitigation proposals
CL-IWR-7	TL87894 18524	Existing to be retained	Pipe	0.45	56	N/A	Drainage culvert	Existing culvert hydraulic capacity assumed to be adequate (See note 2)

**Notes:**

1. The culvert schedule should be read in conjunction with Sheet 14 of 21 and Sheet 20 of 21 of Drainage and Surface Water Plan, included within consultation Map Book 4.
2. Appropriate assumptions have been made where the existing drainage surveys have been found to be incomplete.
3. The new culverts sizes are based on hydraulic modelling undertaken for the Ordinary Watercourses and are to restrict the flows as necessary as part of proposed flood mitigation works.
4. Where existing culverts are proposed to be retained, their condition assessment (including defects identification and remediation work requirements) will be undertaken at the detailed design stage.

Table A.4 Preliminary Ground Investigation Data in the Vicinity of the Attenuation Ponds at the B1023

Proposed Catchment	Pond Elevation from LIDAR (mAOD)	Geology at Pond Location in Accordance to BGS GeolIndex Map	Exploratory Hole	Exploratory Hole Elevation (mAOD)	Exploratory Hole Depth (mbgl)	Exploratory Hole Distance from the Pond (m)	Geology of Exploratory Hole Within Anticipated Pond Depth	Soil Infiltration Rate from Soakaway Test (ms <sup>-1</sup> )	Groundwater Strike / Level (mbgl)	Highest Recorded GW Monitoring Level (mbgl)	Comments, Provisional Assessment of Drainage Conditions and Engineering Assessment of Infiltration Drainage Feasibility
S3-IWR-OU2	38.0/39.0	LOFT	TP6509	38.48	4.0	On	0.30 – 4.0mbgl <b>HEAD</b> (slightly gravelly sandy CLAY)	N/A	Not encountered	N/A	Soakaway drainage unlikely to be feasible Limited groundwater data The design of a lined pond solution may need to be considered as mitigation measures (e.g. clay and or concrete) to reduce the effects of potential uplift
			BH6132	38.06	5.0	On	0.30 – 2.70mbgl <b>HEAD</b> (slightly sandy slightly gravelly silty CLAY) 2.70 – 5.00mbgl <b>LC</b> (slightly sandy CLAY)	N/A	Not encountered	4.36 (limited readings)	
S3-IWR-OU5	44.0/45.0	LC	TP6511	47.36	3.30	On	0.30 - 1.70 <b>HEAD</b> (slightly sandy CLAY with rootlets) 1.70 - 3.30 <b>LOFT</b> (slightly gravelly CLAY with frequent sandy clay layers)	N/A	Not encountered	N/A	
			WS6417	47.88	5.45	70m to the SE	0.30 - 1.20 <b>HEAD</b> (slightly sandy gravelly CLAY) 1.20 - 5.45 <b>LC</b> (CLAY)	N/A	Not encountered	5 (limited readings)	

