A12 Chelmsford to A120 widening scheme
TR010060

6.3 ENVIRONMENTAL STATEMENT

APPENDIX 14.1 WATER QUALITY ASSESSMENT REPORT

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A12 Chelmsford to A120 widening scheme

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ENVIRONMENTAL STATEMENT
APPENDIX 14.1 WATER QUALITY ASSESSMENT REPORT

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1.1.1 Water quality routine runoff and accidental spillage risk assessments have been undertaken to inform the Environmental Statement for the A12 Chelmsford to A120 Widening Scheme and in support of the proposed submission of a Development Consent Order (DCO) for the scheme. These water quality assessments have been undertaken in accordance with standards outlined in the Design Manual for Roads and Bridges (DMRB), with specific reference to DMRB LA 113 Road Drainage and the Water Environment Revision 1 where assessment criteria and methodology are outlined (Highways England, 2020a). To inform the assessments the National Highways (previously Highways England) Water Risk Assessment Tool (HEWRAT) has been used.

1.1.2 The proposed scheme is located within the (main) river catchments of the River Chelmer, River Blackwater and Roman River. Within these catchments, the Boreham Brook and River Ter are large tributaries of the River Chelmer, with the River Brain, Domsey Brook and Rivenhall Brook similarly sized larger tributaries of River Blackwater. The proposed scheme is due to discharge to all these named watercourses along with another 26 minor watercourses and unnamed ditches, some of which are anticipated to have very low flows. Baselines have been produced for every surface water receptor and each receptor has been assigned a value based on its attributes and characteristics.

1.1.3 Before road runoff is discharged to surface watercourses, mitigation measures are proposed in the form of treatment trains containing various Sustainable Drainage Systems (SuDS) components. Where it has been feasible and practical to incorporate SuDS components within the proposed drainage design, the treatment train typically includes a combination of filter drains, attenuation ponds (designed to include permanently wet features), swales and vegetated ditches.

1.1.4 Of the 92 outfalls associated with the proposed scheme, 31 have been assessed for impacts to surface waters. The remaining 61 outfalls discharge to low flow watercourses, which would typically dry up for part of the year thus acting like a soakaway. For these outfalls groundwater assessments have been undertaken in accordance with HEWRAT and DMRB LA 113. The significance of effect has been based upon the groundwater assessments for the low flow watercourses as this is considered to represent the worst-case situation.

1.1.5 Of the 31 outfalls assessed for surface water effects, 26 pass all DMRB LA 113 standards without the consideration of mitigation. For these outfalls the embedded mitigation will provide a betterment above the DMRB standards and legal requirements. It will also provide a betterment upon the existing situation as the A12 has limited treatment for water quality.

1.1.6 For the other five outfalls, without mitigation considered, one failed for sediment-bound pollutants (to Watercourse 17) and two failed the short-term DMRB requirements for Copper (to Rivenhall Brook and Roman River). The remaining two outfalls, both to Domsey Brook, both failed for sediment-bound pollutants, the short-term DMRB requirements and the long-term (annual average concentrations) Environmental Quality Standards (EQS) for copper.

1.1.7 When embedded mitigation is incorporated into the assessments and the outfalls are considered individually, all of the 31 outfalls achieve the DMRB LA 113 standards (i.e. for short-term impacts and sediment-bound pollutants) and the EQS for copper and zinc. As such, the overall magnitude of impact with embedded mitigation is negligible for these outfalls. This results in an overall slight adverse effect for high value watercourses, and for low and medium value watercourses an overall neutral effect.

1.1.8 Of the 12 cumulative outfall assessments undertaken, six pass all DMRB LA 113 standards without mitigation. For these outfalls the treatment of water quality to be provided through SuDS will be a betterment against the DMRB standards and a betterment compared to the existing situation for the existing outfalls. For the six cumulative assessments which did not pass the HEWRAT assessments prior to mitigation, four assessments fail due to short-term impacts. The remaining two assessments fail both the EQS and the short-term DMRB requirements for copper.

1.1.9 With embedded mitigation of the 11 cumulative outfall assessments, 11 pass all DMRB standards. Outfalls (S3 – OU17 and OU18) to the Roman River fail the short-term DMRB requirements for copper, resulting in a minor magnitude of impact and an overall significance of effect of slight adverse for the receiving watercourse, Roman River, a high value receptor. This assessment passed the EQS when mitigation was considered.

1.1.10 In accordance with DMRB LA 113 the one cumulative assessment that failed the long term EQS for soluble copper using HEWRAT, prior to mitigation was subject to an additional detailed assessment. The detailed assessment uses the UK Technical Advisory Group (UKTAG) Rivers and Lakes Metal Bioavailability Assessment Tool (M-BAT). To pass, the EQS which is based upon the annual average concentrations predicted by M-BAT, must be lower than the EQS. M-BAT also allows a site specific Predicted No Effect Concentration (PNEC) to be determined. When M-BAT analysis results are considered, the EQS is achieved for this cumulative assessment and for all assessments (prior to mitigation).

1.1.11 An assessment of the impact that routine runoff may have on groundwater quality has been completed for the low flow watercourses in accordance with the method described in Appendix C of DMRB LA 113 (Highways England, 2020a). This assessment shows that most of the outfalls pose a medium risk to groundwater quality. However, contaminant treatment measures included in the drainage design, which are not considered in the DMRB methodology, are considered to reduce the risk to groundwater quality to low, therefore the residual impact is negligible. Accordingly, no significant effects on groundwater quality are predicted.

1.1.12 The results from the HEWRAT routine runoff assessments outlined above are summarised in Table 1.1.

Table 1.1 Summary of HEWRAT routine runoff assessment

Type of Assessment	Assessments passing all aspects of HEWRAT with mitigation	Environmentally not significant effects with HEWRAT failures (with mitigation)	Environmentally significant effects HEWRAT failures (with mitigation)
Surface water: Single Outfall HEWRAT Assessments (total 31)	26 pass at step 2 All pass at step 3	0 at step 3	0 at step 3
M-BAT analysis	All outfalls achieve the EQS		
Surface water: Cumulative Outfall HEWRAT Assessments (total 12)	11	1	0

1.1.13 Accidental spillage risk assessments have been undertaken using HEWRAT for surface waters and groundwaters. Results from all outfalls indicate the risk of a pollution incident is well within the most stringent threshold of 0.5% (1 in 200 year) annual exceedance probability and thus within acceptable limits in accordance with DMRB LA 113. All accidental spillage risk assessments pass the DMRB standard and have therefore not influenced the overall significance of effect. The accidental spillage risk criteria for assessing both risks to surface and groundwater receptors are the same within the HEWRAT methodology. Therefore, the conclusions outlined apply to both surface water and groundwater receptors.

1.1.14 The HEWRAT routine runoff assessments to surface waters and groundwater associated with the current proposed drainage design, predict that road runoff from the proposed scheme during operation will not have a significant effect on groundwater quality or the surface water environment.

2 Introduction and background

2.1 Introduction

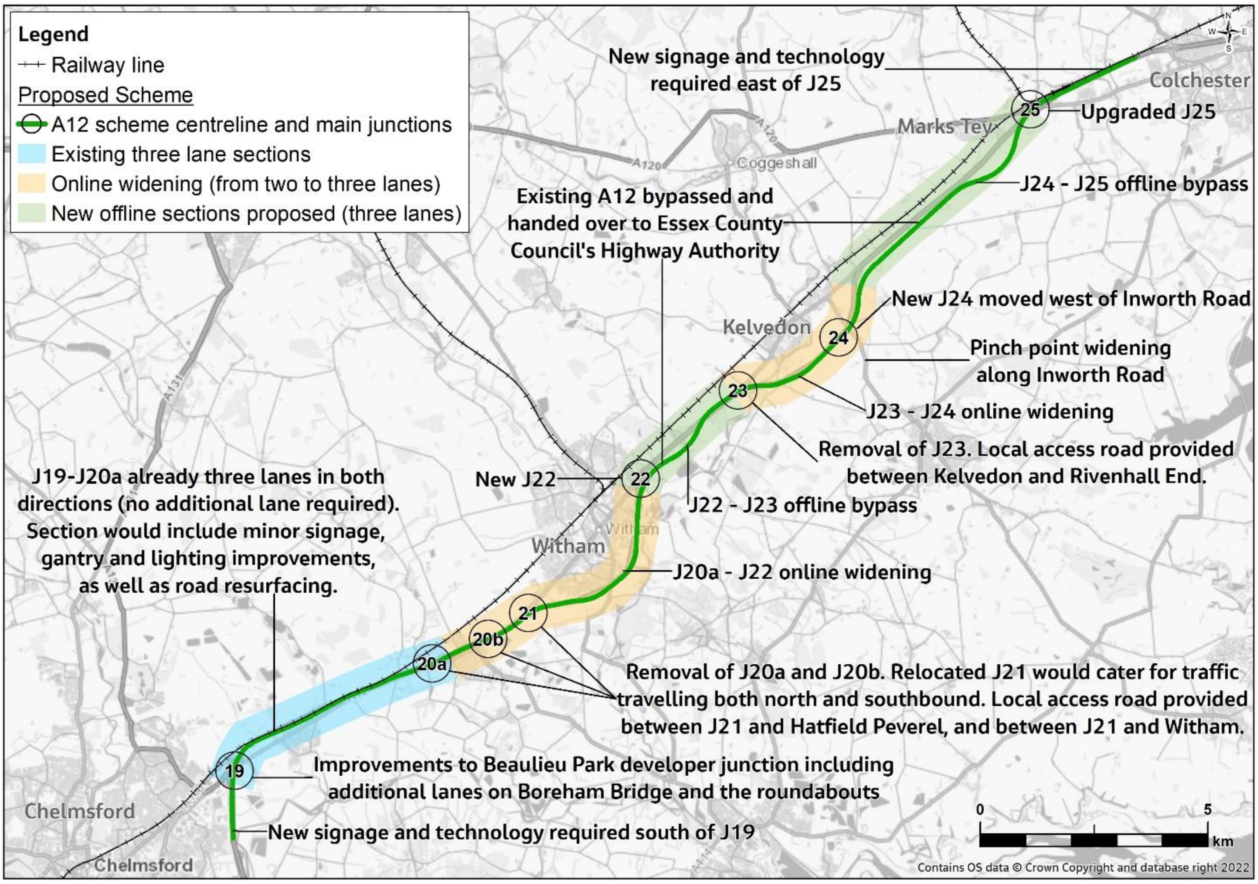
2.1.1 This document presents the assessment of water quality impacts to surface waters and groundwaters due to discharges of road runoff from the highway and accidental spillage risk for the A12 Chelmsford to A120 Widening scheme (the 'proposed scheme') during its operation. This document is an appendix to the Environmental Statement (Chapter 14: Road drainage and the water environment [TR010060/APP/6.1]) and is built upon the assessment presented in the Preliminary Environmental Information Report (PEIR) (Highways England, 2021).

2.1.2 An impact assessment upon water quality has been undertaken using the methods described in the Design Manual for Roads and Bridges (DMRB) LA 113 Road Drainage and the Water Environment Revision 1 (Highways England, 2020a), hereafter referred to as 'DMRB LA 113'. A 'simple' level of assessment has been implemented using the Highways England Water Risk Assessment Tool (HEWRAT) and accompanying user guidance: the HEWRAT v2.0 Help Guide (Highways England, 2015). A 'detailed' level of assessment has also been undertaken using the Rivers and Lakes Metals-Bioavailability Assessment Tool (M-BAT) developed by the Water Framework Directive UK Technical Advisory Group (WFD-UKTAG) and accompanying user guidance (WFD-UKTAG, 2014). The assessments have generated results that have been used to determine the magnitude of impact in accordance with DMRB LA 113. The significance of effect upon the receiving watercourses has then been determined using DMRB LA 104 Environmental Assessment and Monitoring. Revision 1 (Highways England, 2020b).

2.2 Background and context

2.2.1 The proposed scheme comprises improvements to the A12 between Chelmsford at Junction 19 (Boreham) and Colchester at Junction 25 (Marks Tey). A proposed scheme location plan is shown in Plate 2.1 (taken from Chapter 2: The proposed scheme, of the Environmental Statement [TR010060/APP/6.1]). The proposed scheme involves widening the existing A12 to three lanes throughout in each direction. This would involve online widening in the main, with offline bypasses created between junctions 22 and 23 (Rivenhall End Bypass) and 24 and 25 (Kelvedon to Marks Tey). This would be accompanied by junction improvements (junctions 19 and 25), construction of new all movement junctions (junctions 21, 22, and 24), and removal of existing junctions (junctions 20a, 20b, and 23). A detailed description of the proposed scheme is presented in Chapter 2 of the Environmental Statement [TR010060/APP/6.1].

Plate 2.1 Overview of proposed scheme



2.3 Purpose of the assessment

2.3.1 There are two main types of pollution from roads during the operational phase: routine runoff and accidental spillage risk.

2.3.2 Routine runoff consists of road deposits which can contain a range of contaminants such as suspended solids, heavy metals and hydrocarbons. When combined with rainfall, these contaminants can runoff into the highway drainage system which discharges to a watercourse potentially causing pollution. Potential pollution effects can be classified into two types, the first of which can directly affect water quality, typically via increased dissolved metal discharges which can chemically impair biological functions. The second type comprises indirect impacts that can affect the aquatic habitat quality. Typically, this relates to increased sediment transport which can smother feeding and breeding grounds for fish and physically alter the habitat. The aim of undertaking assessments for routine runoff is to establish the nature and severity of the impacts of road drainage and runoff upon surface water and groundwater quality.

2.3.3 Where routine run-off is discharged to surface water features which have been assessed to have low flow conditions (i.e. likely to be dry for part of the year), an assessment of impacts of groundwater quality has been undertaken using a source-pathway-receptor principal to account for the potential infiltration to ground where low or no flow conditions may be present.

2.3.4 This appendix presents the data used to undertake the assessments and the assessment results. Where water quality failures against the DMRB standard are identified, additional mitigation measures have been explored and incorporated into the design and assessment where feasible. The design process has been iterative, and the final results of the assessment are presented in the Chapter 14: Road drainage and the water environment, of the Environmental Statement [TR010060/APP/6.1].

2.3.5 This appendix is supported by the following annexes:

- Annex A DMRB LA 113 and HEWRAT methodology for routine runoff and spillage risk to surface waters
- Annex B Assessment data for surface water
- Annex C Routine runoff results
- Annex D Detailed level assessment using M-BAT
- Annex E Proposed mitigation / SuDS treatment trains
- Annex F Residual significance of effects
- Annex G Figures
- Annex H Groundwater assessment tables

2.3.6 Routine runoff can also pose a risk to groundwater quality, especially when the receiving watercourses have little or no flow. The HEWRAT recognises this and recommends for these watercourses, that may act as soakaways and allow infiltration to groundwater, that it may be more appropriate, dependent upon the underlying geology, to undertake a groundwater quality risk assessment using HEWRAT. At low flows it is likely that a watercourse is ephemeral and/or has a limited, if any aquatic ecology present with the majority of the discharge infiltrating to ground. Based upon flow data and organisational judgement those receiving watercourses with a low flow have been identified. For the proposed scheme, the low flow watercourses both surface water assessments and groundwater risk assessments have been undertaken. The pollutant concentrations from the HEWRAT surface water assessments have also been used in the detailed groundwater risk assessments. Groundwater assessments are reported in Section 5 of this appendix and Annex C and H. Groundwater impact assessments are also documented and summarised in Chapter 14: Road drainage and the water environment, of the Environmental Statement [TR010060/APP/6.1].

2.3.7 Accidental spillage risk assessments have been undertaken to determine the level of risk for surface waters and groundwaters, whether the level of risk is acceptable or whether mitigation measures are required. The methodology for spillage risk assessments for the proposed scheme is described further in Section 3.3. Spillage risk assessments for groundwater follows the same methodology as surface water assessments, and requires the same inputs as defined in DMRB LA 113. Therefore, the results for spillage risk for surface water and groundwater are both presented in Section 6 of this appendix.

3 Assessment methodology and approach

3.1 Surface water routine runoff assessment – simple level

3.1.1 The Water Environment (Water Framework Directive) Regulations (2017) require that all inland and coastal waters achieve ‘good’ water quality status by 2027. One of the measures used to assess compliance with this requirement are Environmental Quality Standards (EQS). An EQS is the concentration of a chemical in the environment below which there is not expected to be an adverse effect on the specific endpoint being considered, e.g. the protection of aquatic life. A water body cannot achieve good status if the EQS for any Priority/Priority Hazardous Substance or Specific Pollutant, is exceeded.

3.1.2 The simple level assessment of impacts from routine runoff to surface waters uses HEWRAT, as described in DMRB LA 113 (Highways England, 2020a) and the HEWRAT Help Guide (Highways England, 2015). The methodology is described in further detail in Annex A. Outfalls are assessed individually as single discharges of routine runoff. Where discharges to the same reach of a watercourse are proposed through more than one outfall, a cumulative assessment is also undertaken using HEWRAT. For outfalls located within 100m of each other, a cumulative assessment can be used to report sediment related impacts. For outfalls located between 100m and 1km of each other, a cumulative assessment can be undertaken for soluble pollutant impacts. Cumulative assessments have been undertaken where appropriate.

3.1.3 For the assessment of the long-term risks HEWRAT estimates in-river annual average concentrations for the soluble pollutants dissolved copper and dissolved zinc. Both metals can be eco-toxic and there are well defined Environmental Quality Standards (EQS) for acceptable permissible concentrations of both in the water environment. The EQS for bioavailable dissolved copper in freshwater is currently 1.0µg/l. For zinc, an outfall passes if the contribution of bioavailable dissolved zinc is less than 10.9µg/l. Copper and Zinc are specific pollutants with limits listed in The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015, Part 2. The EQS are based upon long-term annual average concentrations. Copper and Zinc are used in the HEWRAT assessment as a proxy for other pollutants.

3.1.4 The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015 does not contain short-term limits for these pollutants. Due to the intermittent nature of road runoff short-term standards were developed through research related to the toxicological effects on aquatic invertebrates from road runoff (for copper and zinc). Through this collaborative research short-term standards were developed and agreed with the Environment Agency. These short-term standards (called Runoff Specific Thresholds (RST)) are published in the HEWRAT Help Guide (v2.04) (Highways England, 2015) and are assessed using HEWRAT. Sediment bound pollutants (including Priority Substances such as Polyaromatic hydrocarbons (PAHs) and some heavy metals) are also considered using HEWRAT. Further details on the HEWRAT methodology and pollutants are presented in Annex A.

3.1.5 For the short-term (i.e. acute) risks the RSTs established within the HEWRAT model consider a 6-hour (RST6) and 24-hour period (RST24) and limits relate to the allowable number of exceedances per year of these thresholds. The RST6 allowable exceedance is 1 per year for both copper and zinc. RST6 represents more typical conditions designed to protect against more typical exposure conditions of aquatic organisms to soluble pollutants in highway runoff. The RST6 results are indicative of the water quality within a watercourse the majority of the time. The RST24 allowable exceedance is 2 per year for both copper and zinc. The RST24 is designed to protect against the worst-case conditions. The RST24 results are likely to occur on a very irregular basis but when they do are likely to have significant impacts upon water quality within the receiving watercourse and aquatic ecosystems. Where a discharge is within 1km of a designated nature conservation site the allowable exceedances per year is halved for both copper and zinc thresholds, i.e. RST24 is 1 and RST6 is 0.5.

3.1.6 The HEWRAT also provides assessment for the impact of sediment bound pollutants (total copper, zinc, cadmium, pyrene, fluoranthene, anthracene, phenanthrene and total Polyaromatic hydrocarbons (PAH) and identifies whether accumulation of sediments will occur. If sediment is expected to accumulate, the potential extent of sediment coverage (the deposition index (DI)) is also considered. A DI of less than 100 is required to pass the sediment-bound pollutant limit in HEWRAT.

3.1.7 The assessment methodology can be considered to be a process-based treatment model. HEWRAT provides results which are taken as an indicator as to whether there is sufficient dispersion and dilution available within the receiving water body to limit the impacts of highway runoff to acceptable levels.

3.1.8 HEWRAT adopts a tiered consequential approach to assessment and can report the results (as a ‘Pass’ or ‘Fail’) at three different stages depending upon the level of assessment required for any given site. This is described in further detail in Annex A. The stages are:

- Step 1, the runoff quality (prior to any pre-treatment and discharge into a water body)
- Step 2, in river impacts (after dilution and dispersion)
- Step 3, in river impacts post-mitigation (i.e. allows the effectiveness of proposed mitigation (treatment) measures to be tested)

3.1.9 Road drainage (subject to no treatment) can contain a wide range of pollutants. Step 1 of the HEWRAT routine runoff assessment estimates the concentration ranges of selected pollutants based on traffic volume and likely climatic conditions. As no forms of treatment (via dilution provided by a receiving watercourse) are considered at Step 1, assessments failures are almost exclusively reported. Due to this expected failure, Step 1 results have not been undertaken.

3.1.10 The focus at this stage has been on the Step 2 and Step 3 assessments for dissolved metals and sediments. The HEWRAT facilitates two types of assessment at the Step 2 stage for sediment-bound pollutants, a simpler Tier 1 assessment requiring only a river width at low flows value and a more advanced Tier 2 assessment which requires specific channel dimensions. Tier 2 assessments are only typically utilised where Tier 1 assessments fail.

3.1.11 HEWRAT Step 3 assessments allow a % treatment efficiency to be applied for copper, zinc and sediments. This provides an indication as to whether proposed mitigation is sufficient for the predicted discharge of routine runoff to pass the assessment for both sediment bound and soluble pollutants. The degree of mitigation required can be investigated iteratively using Step 3 of HEWRAT.

3.1.12 The percentage of treatment required indicates the percentage by which the concentrations of soluble pollutants in the runoff will need to be reduced in order to achieve compliance with the toxicological thresholds.

3.1.13 Treatment efficiencies used in the assessments are presented in Annex E and have been calculated based on information and treatment efficiency values for individual Sustainable Drainage Systems (SuDS) components presented in DMRB CG501 Design of Highway Drainage Systems Revision 2 (Highways England, 2020c), (section 8 – Table 8.6.4 N3 Pollution and flow control measures options).

3.1.14 The treatment percentages, taken from DMRB CG501 and used in the Step 3 assessments are very precise, however, current best practice does not provide precise, accurate or robust treatment efficiencies for the available treatment options. Therefore, a degree of pragmatism is required when designing a drainage system to meet the required treatment percentages.

3.1.15 In some instances, multiple SuDS treatments may be incorporated into a (proposed) drainage catchment i.e. SuDS treatment trains. In these instances, a total treatment efficiency value is required to be calculated which represents that specific SuDS treatment train. No explicit advice is given within the DMRB standard on how to calculate the combined efficiency of multiple SuDS treatment components in a management train. The approach taken to establish combined treatment efficiencies for treatment trains has been to simply multiply the efficiency value of each treatment component within the treatment train. Further detail regarding this method is presented in Annex A and this approach has been taken in the assessments with the treatment train efficiencies used presented in Annex E. Restrictions on providing a particular number of SuDS treatment components is normally constrained either by land available and/or local topography.

3.2 Surface water routine runoff assessment – detailed level

3.2.1 EQS limits for a number of metals (including copper) have been established based on their bioavailable concentration (i.e. $EQS_{bioavailable}$). The bioavailability fraction of a metal is responsible for toxic effects in flora and fauna. The amount of metal that is actually bioavailable and the toxicity of metals is dependent on a range of water quality parameters/local water chemistry including pH, dissolved organic carbon (DOC) and water hardness.

3.2.2 The bioavailability of a metal depends on several physico-chemical factors, which governs both metal behaviour and the interactions of the toxic forms of the metals with a biological receptor. For example, if the metal ions bind to carbonate ions or DOC, they are less 'bioavailable' and thus less likely to be able to bind to the organism and have an adverse effect.

3.2.3 To determine the bioavailable concentration of a metal directly, specifically copper, zinc, manganese and nickel, the M-BAT (WFD-UKTAG, 2014) has been utilised as described further in Annex D. The key output of the M-BAT is an estimate of the bioavailable concentration of a metal under the conditions found at a site, which can then be compared with the $EQS_{bioavailable}$ to assess compliance.

3.2.4 As stated in the UK-TAG guidance a further output is the $PNEC_{dissolved}$. This is the Predicted No Effect Concentration (PNEC). This concentration is derived from the ecotoxicological data and site-specific water quality data using M-BAT, and so is the total dissolved concentration for a metal at which point the bioavailable concentration of that metal equals the EQS threshold value. For example, for the River Blackwater, where the PNEC for dissolved copper is ~13.54 ug/l, 1.0 ug/l will be bioavailable, and meeting the EQS value. Therefore, the $PNEC_{dissolved}$ value can be considered a site specific EQS value (expressed as dissolved concentration).

3.2.5 The M-BAT also calculates a site-specific bioavailability factor (BioF). The HEWRAT calculates the total concentration of copper and zinc within the watercourse and assumes this concentration is 100% bioavailable and assesses this concentration against EQS values. This is a cautious approach and therefore HEWRAT often triggers failures against EQS values. This conversion factor can be used to convert these concentrations generated by HEWRAT into a bioavailable concentration of principally copper or zinc. Even when EQS values are exceeded in HEWRAT routine runoff assessments, utilising a site-specific BioF can demonstrate bioavailability of that particular heavy metal is lower than the EQS concentration, subsequently demonstrating compliance with this parameter.

3.2.6 Background concentrations can also be considered in HEWRAT for copper when assessing monitoring results against the EQS. For an outfall to pass the contribution of bioavailable dissolved copper from the outfall combined with the ABC of bioavailable dissolved copper must not exceed this EQS. During an investigation of an EQS failure, consideration should be given to the potential influence of ambient background concentrations (ABC) for copper at the particular site being studied.

3.2.7 An ABC for copper can be included (details of values used for the proposed scheme are described in Section 4) as part of HEWRAT assessments that fail the EQS for copper without prior inclusion of an ABC. This methodology generates an overall total EQS copper concentration predicted at routine runoff discharge outfalls (i.e. assessment results inclusive of ABC). As HEWRAT assumes 100% copper is bioavailable, including ABC values will very often trigger an EQS failure for copper as ABC values for copper are typically greater than 1.0 ug/l.

3.2.8 The overall total EQS copper concentration generated in HEWRAT (i.e. the routine runoff concentration plus the ABC) predicted for each outfall, should be used within the corresponding M-BAT assessment. This again generates the most conservative results. The assessment methodology does not consider ABC for zinc as an input parameter in HEWRAT.

3.3 HEWRAT spillage risk assessment

3.3.1 For all roads, there is a risk that a spillage or vehicle fire may lead to an acute pollution incident. Generally, the risk on any road is proportionate to the risk of a Heavy Goods Vehicle (HGV) road traffic collision. As new or improved roads are designed to reduce the collision rate, they should also lead to fewer acute pollution impacts. Where spillages do reach a surface watercourse the pollution impact can be severe, but is usually of short duration, typical of an acute pollution impact.

3.3.2 The spillage risk assessment within DMRB LA 113 has been designed to calculate spillage risk during the operation of the proposed scheme and the associated probability of a serious pollution incident and is described further in Annex A. The method initially estimates the risk that there will be an incident causing the spillage of a potentially polluting substance on the length of road being assessed. It then calculates the risk, assuming a spillage has occurred, that the pollutant will reach and impact on the receiving watercourse. The risks are expressed as annual probabilities of such an event occurring. In accordance with DMRB LA 113, cumulative spillage risk assessments should be undertaken when more than one outfall discharges into the same watercourse. Spillage risk assessment for groundwater follows the same methodology and uses the inputs used for surface water and therefore the results presented in Section 6 are representative of the spillage risk to surface waters and groundwater.

3.3.3 The risk of a serious pollution incident is deemed within acceptable limits if the Annual Exceedance Probability (AEP) is less than 1% (i.e. a 1 in 100-year return period or greater). Where the spillage is within 1km of a sensitive area the risk of a serious pollutant incident is deemed within acceptable limits if the AEP is less than 0.5% (i.e. a 1 in 200-year return period or greater).

3.4 Existing drainage

3.4.1 The existing highway drainage information for the proposed scheme has been obtained primarily from drainage surveys (i.e. drainage connectivity and condition assessment surveys (CCTV surveys)) that were undertaken prior to the Project Control Framework Stage 3 preliminary design stage. Other sources of information related to existing highway drainage included the National Highways Drainage Data Management System (DDMS), available drainage construction drawings/As-Built drainage records and limited topographical survey information for existing outfalls and watercourse alignments in the vicinity of existing outfalls. There are 59 outfalls that are associated with the existing highway (and within the proposed scheme extent). Further details are provided in Appendix 14.6: Surface water drainage strategy, of the Environmental Statement [TR010060/APP/6.3].

3.5 Scope of assessment and approach

3.5.1 The proposed scheme is split into three design sections as follows:

- Section 1 – works between junction 19 and the existing junction 21
- Section 2 – works between the existing junction 21 and existing junction 23
- Section 3 – works between the existing junction 23 and junction 25

3.5.2 The three design sections run west to east from Chelmsford to Colchester. The outfalls within each section are also numbered from west to east and have been numbered according to the sections they are in with numbering commencing again for each new section. For example, outfall S1-OU01 is outfall OU01 in design section 1.

3.5.3 The Annual Average Daily Traffic (AADT) used in the routine runoff assessments has been taken from the traffic model used for the proposed design. In line with the precautionary principle, where values have been predicted by the traffic models to be within 10% of an AADT banding threshold, the upper AADT banding has been used within HEWRAT. In accordance with DMRB LA 113 design year traffic flows have been used.

3.5.4 In the absence of proposed outfall locations prior to design commencing for the PEIR stage, Q_{95} values were purchased from Wallingford HydroSolutions using their LowFlow Solutions software. The Q_{95} values for each location where the proposed scheme crossed a watercourse (28 locations) were obtained and these are presented on Figure 14.1.1 (Annex G). For each outfall the Q_{95} location closest and on the same watercourse in a downstream direction to the outfall was used in a proportional area calculation to calculate a Q_{95} value for the outfall location.

3.5.5 When a Q_{95} value was not available that was considered to be representative of the watercourse or when a Q_{95} value calculated was less than the minimum value in HEWRAT (of one litre per second), the watercourse can be considered to act as a soakaway. At flows lower than this it is likely that a watercourse is ephemeral and/or has a limited, if any aquatic ecology present. In line with standards outlined in DMRB LA 113 (paragraph 3.25), if the Q_{95} flow is estimated to be less than one litre per second (i.e. $<0.001\ m^3/s$) then a simple groundwater risk assessment should be undertaken.

3.5.6 The proposed drainage design includes 113 proposed outfalls. Of these 92 will discharge road runoff from the proposed scheme. The other 21 outfalls have been identified as discharging earthworks drainage only (i.e. absent of road runoff), meaning no assessment was required.

3.5.7 Of the 92 outfalls discharging road runoff associated with the proposed scheme 61 outfalls have been identified as discharging to watercourses where the Q_{95} is anticipated to be low (i.e. less than one litre per second). For these locations groundwater risk assessments have been undertaken using HEWRAT. Of the 61 outfalls 32 are new outfalls and of these 19 will be owned by Essex County

Council (ECC) and 13 by National Highways. The remaining 29 outfalls are existing outfalls.

3.5.8 The results of the groundwater assessments have been used to determine the magnitude of impact for these watercourses and the significance of effect. These assessments are reported in Section 5 of this appendix and Annex H as well as being summarised in Chapter 14: Road drainage and the water environment, of the Environmental Statement [TR010060/APP/6.1]. For these outfalls surface water assessments at Step 2 and Step 3 have also been undertaken for soluble pollutants based upon the lowest Q_{95} value and these are presented in Annex E. These results have been used to provided pre and post treatment pollutant concentrations for comparison in the groundwater risk assessment and also provide a form of sensitivity analysis in relation to surface waters.

3.5.9 It should be noted that some outfall locations, catchment areas and receiving watercourses have changed due to design development from those presented at PEIR (Highways England, 2021).

3.5.10 When considering results produced by HEWRAT for both routine runoff and spillage risk, DMRB LA 113 and the HEWRAT Help Guide refer to more stringent criteria for sites protected for nature conservation. A requirement of the tool includes input as to whether the outfall is within 1km of a Site of Special Scientific Interest (SSSI). Several outfalls are within 1km of Marks Tey SSSI which is solely designated for geological purposes. As the purpose of the water quality assessments is to protect aquatic ecology the designation of Marks Tey SSSI has been disregarded and the non-designated site criteria used when establishing magnitude of impact using the HEWRAT results.

3.5.11 Similarly, several outfalls within the proposed scheme are located within 1km of two local natures reserves (LNRs), Whetmead and Brockwell Meadows. The LNRs are not considered designated sites which qualify for Protected Site status, in relation to HEWRAT routine runoff assessments as they are not protected or designated under UK legislation. Therefore, the applicable outfalls within 1km of these sites are also not subject to the most stringent assessment criteria.

3.5.12 At the PEIR stage several watercourses were classed as Very High value receptors in relation to the water environment due to their previous fisheries designations. Salmonid terminology found in Table 3.70 of DMRB LA 113 was linked to the Freshwater Fish Directive (2006/44/EC). The Directive was repealed in 2013 and the same level of environmental protection was established within the Water Framework Directive (WFD). As such the ‘designated salmonid/cyprinid fisheries’ now no longer exists and watercourses either have fish as a biological quality element or they do not. The presence of fish as a biological quality element for watercourses has not been considered when determining the value of a receiving watercourse as a water environment feature to avoid duplication of effects with the biodiversity assessment. This has resulted in these watercourses being considered as High value surface water receptors for the assessments presented in the Environmental Statement and this document.

3.5.13 Treatment train efficiencies have also been refined compared to those presented in the PEIR, to include the percentage of each catchment that will receive treatment from each solution, as opposed to assuming 100% of the catchment was treated by every proposed SuDS solutions at the PEIR stage. All data are presented in Annex B and Annex E.

3.5.14 Where an outfall passes at Step 2 resulting in a negligible impact typically no further assessment or mitigation is required. For the majority of outfalls that pass at Step 2, where feasible, SuDS measures have been incorporated into the drainage design for attenuating flows. These features will also provide a water quality enhancement and for these outfalls these measures have been subject to a Step 3 assessment. The Step 2 results (i.e. pre-mitigation) are presented in Table C.1 in Annex C. With these enhancements included the Step 3 results are presented in Table 4.2 in Section 4.3 of this appendix for these outfalls that passed at Step 2 along with the treatment trains for all outfalls. For low flow watercourses that have been assessed for groundwater impacts, the Step 3 surface water HEWRAT results are presented in Table C.3 in Annex C.

3.5.15 Spillage risk assessments were undertaken based on the drainage design and traffic model associated with the proposed design, in accordance with the DMRB LA 113 standard, without mitigation.

3.6 Summary of limitations and assumptions

3.6.1 The following limitations have been identified:

- The assessments are based upon the latest and most up-to-date designs for the proposed drainage design, available at the time of writing. The proposed scheme design at DMRB Project Control Framework Stage 3 will be subject to detailed design during future stages of the project. Therefore, design details included in these assessments are subject to change based on future iterations of the design of the proposed scheme at later Project Control Framework Stages.
- Some details associated with the assessments have been established through a desktop study and for example, informed by photographs taken during ecological site visits. For Tier 2 sediment assessments the required topographic information (i.e. bed width, Mannings N, side slope and long slope) were provided by the project drainage team and based upon topographic surveys where available or based upon organisational judgement where topographic data was not available.

3.6.2 This study is based upon the following assumptions:

- The HEWRAT assessments for routine runoff have been undertaken assuming that the permeable area contributing to the total catchment area is zero. This is assumed as the earthworks drainage is separate in some catchments and provides a worst-case scenario for others. Permeable areas are estimated to have relatively lower concentrations of pollutants than discharges from impermeable areas and thus add to the dilution of any routine runoff. In the majority of the proposed scheme the earthworks drainage (i.e. the permeable grassed verge and bank areas) are also discharged via separate outfalls rather than with the road drainage.

- The HEWRAT requires the input of the river width at the Q95 flow. The HEWRAT v2.0 Help Guide defines this as the surface flow width of the stream at the annual Q95 river flow. The HEWRAT Help Guide does not prescribe a methodology on how this should be measured or calculated but says this should be estimated by desk study. For the assessments presented a minimum value of 0.5m has been used. Where considered to be greater than this the value used has either been estimated using desk-based sources (including photos from ecological site visits) and organisational judgement. The values used in the routine runoff assessments are presented in Annex B. The values used may differ from those used for the PEIR assessments which assumed a minimum river width at the Q95 flow of 0.1m.

3.6.3 Where assumptions or uncertainties in the input data used in the HEWRAT and M-BAT assessments have been identified, these have been highlighted in Annex B and Annex D respectively.

3.6.4 The mitigation solutions included in the current drainage design have only considered those constraints for which data is available at this stage (i.e. site constraints such as ground conditions, nature conservation sites and contaminated land) any other considerations which may affect feasibility of implementing the proposed mitigation solutions (e.g. the presence of utilities, legal agreements and land requirements) have not been considered at this stage. All constraints affecting feasibility would be considered at Project Control Framework Stage 5 during detailed design.

4 Surface water routine runoff results

4.1 Introduction

4.1.1 For the proposed scheme, Step 2 and Step 3 assessments were undertaken using HEWRAT. Step 2 Tier 1 assessments (i.e. pre-embedded mitigation) were undertaken based upon the input parameters presented in Annex B for the proposed scheme. The results of the Step 2 HEWRAT single and cumulative assessments are presented in Annex C.

4.1.2 HEWRAT Step 3 assessments have been undertaken for all outfalls and these are presented in Annex E. Step 3 assessments allow proposed mitigation measures to be included and identify if any residual failures require further mitigation. Where outfalls passed Step 2 assessments, Step 3 results represent the betterment in water quality which the proposed scheme is anticipated to provide. This section presents the results of the Step 3 HEWRAT assessments for those surface waters which are not low flow watercourses (i.e. assessed for groundwater risks) and indicates whether outfalls passed the Step 2 assessment (i.e. a betterment is provided) or specifically what aspects were failed at this stage. Where a Step 2 Tier 2 sediment assessment has been undertaken for any specific outfall, this has also been presented in the results tables, otherwise it can be assumed the assessment passed at Step 2 Tier 1. The results presented have been used to inform the magnitude of impact.

4.1.3 Within the results tables below, a traffic light system has been used to aid interpretation: green shading indicates a HEWRAT ‘pass’, and red shading indicates HEWRAT ‘fail’. Additionally, where ‘(Alert)’ text is included alongside a ‘Pass’ result for sediment bound pollutants, this indicates the receiving watercourse is within 1km of a designated for nature conservation site and/or to highlight that there is a downstream structure (i.e. lake, pond, canal) within 100m of the point of discharge. Further details on protected sites are presented in Annex B. Any ‘Alert’ result generated by HEWRAT for sediment bound pollutants indicates a Pass result for that parameter.

4.1.4 All the input data used in the assessments is presented in Annex B and receiving watercourses are shown in Figure 14.1.2 in Annex G for single outfall assessments and in Figure 14.1.3 in Annex G for cumulative assessments.

4.2 A12 proposed mitigation

4.2.1 Details of the proposed embedded mitigation associated with each drainage catchment is presented in Annex E. The proposed drainage design includes vegetated ditches, filter drains, swales and attenuation ponds (which are being designed to allow them to be permanently wet), and all these features are proposed, in varying combinations, to provide some treatment for water quality where feasible. This embedded mitigation has been used to inform the Step 3 assessments.

4.2.2 The treatment efficiencies of the SuDS treatment solutions included within the proposed scheme at present are detailed in Table 4.1 and have been taken from DMRB CG501 (Highways England, 2020c). The total treatment train efficiencies used in the assessments are presented in Annex E.

Table 4.1 A12 treatment efficiencies used within the HEWRAT assessments (taken from DMRB CG501, Highways England, 2020c)

Name of measure	Indicative Treatment Efficiencies		
	Total Suspended Solids (TSS) (% removal)	Copper (Dissolved) (% removal)	Zinc (Dissolved) (% removal)
Combined surface and sub-surface drains / filter drain	60	0	45
Ditches (Vegetated) Filter Strips	25	15	15
Detention Basin (dry)	50	0	0
Attenuation Pond (wet)	60	40	30
Swale / grassed channel	80	50	50
Vortex grit separator	40	0	15
Wetland	60	30	50

4.2.3 As Table 4.1 indicates, SuDS options offering treatment for soluble copper and/or zinc are limited in comparison to all SuDS features listed offering some form of Total Suspended Solids (TSS) treatment. The SuDS features that offer the best soluble treatment efficiencies (attenuation ponds, swales and wetlands) typically require more land/space than other options and these features have been included in the proposed design where feasible.

4.3 Routine runoff assessment results

4.3.1 The results of the HEWRAT Step 3 routine runoff assessments associated with outfalls to surface waters outlined for the proposed scheme, are shown in Table 4.2 for single outfalls. Of the 92 total single outfalls 31 have been assessed for impacts to surface waters. The remaining 61 are assessed for impacts to groundwater as described in Section 3.5 and these results are presented in Section 5 and Annex C and H. Of the 31 outfalls assessed to surface waters 20 are existing outfalls and 11 are new outfalls. Of the existing outfalls 13 are National Highways assets and seven are ECC assets. Of the 11 new outfalls seven will be National Highways outfalls and four will be ECC outfalls.

4.3.2 A total of 12 cumulative assessments have been undertaken for the surface waters impact assessment. Table 4.3 below presents the results of the 12 cumulative assessments for soluble pollutants associated with routine runoff. Of the 12 total cumulative assessments undertaken four included a sediment assessment component, i.e. the outfalls involved are less than 100m apart and these are presented in Table 4.4. The results present the residual impacts from routine runoff after embedded mitigation measures have been considered. These assessments have been initially undertaken with the ABC for copper set at 0.0µg/l. The ABC for copper has not been included in the Step 3 HEWRAT assessments as the background levels are greater than the EQS limits and thus all assessments would by default, with mitigation, fail due to the ABCs for copper and trigger the requirement for a detailed assessment using M-BAT. The EQS, including the ABC for copper, has been used for the M-BAT assessments where these have been required, which are detailed in Section 3.

4.3.3 Where ‘Passive treatment’, ‘No attenuation’, ‘Underground storage units’ or ‘Online storage’ is noted exclusively within the ‘Embedded Mitigation proposed’ column in Table 4.2, for these outfalls the Step 2 results have been presented (i.e. the mitigation proposed offers no quantitative treatment so the Step 3 assessment results are the same as the Step 2 results).

4.3.4 For sediment bound pollutants, DI is reported in brackets if applicable and Tier 1 assessments were undertaken unless otherwise stated in the column in Table 4.2 and Table 4.4.

4.3.5 The assessment results presented in Table 4.2 highlight outfalls that passed all HEWRAT limits at the Step 2 stage and did not require mitigation to be provided to pass a HEWRAT assessment (i.e. to achieve a non-significant effect). Of the 20 existing outfalls assessed to surface waters 19 outfalls pass the Step 2 assessment. These outfalls demonstrate improvement / betterment to surface water quality due to the absence of mitigation for the existing road. The remaining existing outfall (S3_OU17), is a National Highways outfall that fails the RST24 and RST6 for copper at Step 2 and passes all assessments at Step 3 (i.e. with mitigation). The HEWRAT assessments have been undertaken of the existing outfalls and these are presented in Table C.5 in Annex C. The full extent of water quality betterment compared to the existing situation cannot be fully quantified as the contributing catchment areas for each existing outfall have changed due to the proposed scheme a direct comparison for individual outfalls cannot be made.

Table 4.2 HEWRAT routine runoff single outfalls results to surface waters at Step 3 post-mitigation (for non-low flow watercourses)

Outfall Number	Step 2 assessment (pre-mitigation) result (Pass (all aspects) or details of failure)	Receiving Watercourse	Embedded Mitigation proposed (numbers in brackets represent the % of the drainage catchment treated by the proposed solution).	Step 3 Annual Average Concentration related to EQS Compliance (ABC for Copper = 0.0µg/l): EQS Copper = 1.0µg/l and Zinc = 10.9µg/l		Step 3 Acute Soluble Copper & Zinc Number of exceedances per year (RST exceedance limits in brackets)				Step 3 Sediment Bound Pollutants (Pass / Fail)
				Copper (µg/l)	Zinc (µg/l)	Copper RST24 (2)	Copper RST6 (1)	Zinc RST24 (2)	Zinc RST6 (1)	
S1 - OU01	Pass	River Chelmer	Filter Drain (41%), Underground Storage Units, Attenuation Pond (95%)	0.02	0.05	0.00	0.00	0.00	0.00	Pass
S1 - OU10	Pass	Boreham Brook	Filter Drains (3%), Underground storage units	0.04	0.09	0.00	0.00	0.00	0.00	Pass
S1 - OU10A	Pass	Boreham Brook	Underground storage units	0.01	0.02	0.00	0.00	0.00	0.00	Pass
S1 - OU11	Pass	Boreham Brook	Filter Drain (68%) & Attenuation Pond	0.13	0.34	0.00	0.00	0.00	0.00	Pass
S1 - OU12	Pass	Boreham Brook	Filter Drain (8%) & Attenuation Pond	0.19	0.70	0.20	0.00	0.00	0.00	Pass

Outfall Number	Step 2 assessment (pre-mitigation) result (Pass (all aspects) or details of failure)	Receiving Watercourse	Embedded Mitigation proposed (numbers in brackets represent the % of the drainage catchment treated by the proposed solution).	Step 3 Annual Average Concentration related to EQS Compliance (ABC for Copper = 0.0µg/l): EQS Copper = 1.0µg/l and Zinc = 10.9µg/l		Step 3 Acute Soluble Copper & Zinc Number of exceedances per year (RST exceedance limits in brackets)				Step 3 Sediment Bound Pollutants (Pass / Fail)
				Copper (µg/l)	Zinc (µg/l)	Copper RST24 (2)	Copper RST6 (1)	Zinc RST24 (2)	Zinc RST6 (1)	
S1 - OU13	Pass	River Ter	Filter Drain (33%) & Attenuation Pond	0.06	0.19	0.00	0.00	0.00	0.00	Pass
S1 - OU15	Pass	River Ter	Online Storage	0.02	0.06	0.00	0.00	0.00	0.00	Pass
S1 - OU17	Pass	River Ter	Filter Drain (54%)	0.11	0.28	0.00	0.00	0.00	0.00	Pass
S2 - OU04	Pass	River Brain	Attenuation Pond	0.02	0.08	0.00	0.00	0.00	0.00	Pass
S2 - OU05	Pass	River Brain	Online Storage	0.02	0.08	0.00	0.00	0.00	0.00	Pass
S2 - OU15D1	Pass	River Blackwater	Passive Treatment	0.00	0.00	0.00	0.00	0.00	0.00	Pass (Alert D/S structure)
S2 - OU15G	Fails Cu RST24	Rivenhall Brook	Filter Drain (14%) & Attenuation Pond	0.39	1.41	0.80	0.20	0.00	0.00	Pass

Outfall Number	**Step 2 assessment (pre-mitigation) result (Pass (all aspects) or details of failure)**	**Receiving Watercourse**	**Embedded Mitigation proposed (numbers in brackets represent the % of the drainage catchment treated by the proposed solution).**	**Step 3 Annual Average Concentration related to EQS Compliance (ABC for Copper = 0.0µg/l): EQS Copper = 1.0µg/l and Zinc = 10.9µg/l**		**Step 3 Acute Soluble Copper & Zinc Number of exceedances per year (RST exceedance limits in brackets)**				**Step 3 Sediment Bound Pollutants (Pass / Fail)**
				Copper (µg/l)	**Zinc (µg/l)**	**Copper RST24 (2)**	**Copper RST6 (1)**	**Zinc RST24 (2)**	**Zinc RST6 (1)**	
S2 - OU15H	Pass (sediments at Step 2 Tier 2)	Ordinary Watercourse 17	Attenuation Pond	0.25	0.65	0.20	0.00	0.00	0.00	Pass (Alert D/S structure)
S2 - OU17	Pass	Existing Drainage (to Blackwater*)	Passive Treatment	0.00	0.00	0.00	0.00	0.00	0.00	Pass (Alert D/S structure)
S2 - OU18	Pass	River Blackwater	Filter Drain (22%) & Attenuation Pond (70%), Passive Treatment (30%)	0.00	0.00	0.00	0.00	0.00	0.00	Pass
S2 - OU19	Pass	River Blackwater	Attenuation Pond	0.01	0.02	0.00	0.00	0.00	0.00	Pass
S2 - OU24	Pass	Rivenhall Brook	Filter Drain (58%) & Online Storage	0.04	0.07	0.00	0.00	0.00	0.00	Pass (Alert D/S structure)

Outfall Number	Step 2 assessment (pre-mitigation) result (Pass (all aspects) or details of failure)	Receiving Watercourse	Embedded Mitigation proposed (numbers in brackets represent the % of the drainage catchment treated by the proposed solution).	Step 3 Annual Average Concentration related to EQS Compliance (ABC for Copper = 0.0µg/l): EQS Copper = 1.0µg/l and Zinc = 10.9µg/l		Step 3 Acute Soluble Copper & Zinc Number of exceedances per year (RST exceedance limits in brackets)				Step 3 Sediment Bound Pollutants (Pass / Fail)
				Copper (µg/l)	Zinc (µg/l)	Copper RST24 (2)	Copper RST6 (1)	Zinc RST24 (2)	Zinc RST6 (1)	
S2 - OU24A	Pass	Rivenhall Brook	Filter Drain (13%) & Attenuation Pond	0.03	0.06	0.00	0.00	0.00	0.00	Pass (Alert D/S structure)
S2 – OU27	Pass	River Blackwater	Online Storage	0.00	0.00	0.00	0.00	0.00	0.00	Pass
S3 - OU01	Pass	River Blackwater	Filter Drain (24%) & Attenuation Pond	0.01	0.04	0.00	0.00	0.00	0.00	Pass
S3 - OU05	Pass	River Blackwater	Attenuation Pond	0.00	0.00	0.00	0.00	0.00	0.00	Pass
S3 - OU08	Pass	Domsey Brook d/s	Attenuation Pond	0.11	0.41	0.00	0.00	0.00	0.00	Pass
S3 - OU08A	Pass	Domsey Brook d/s	Filter Drain (74%) & Attenuation Pond	0.14	0.36	0.00	0.00	0.00	0.00	Pass

Outfall Number	Step 2 assessment (pre-mitigation) result (Pass (all aspects) or details of failure)	Receiving Watercourse	Embedded Mitigation proposed (numbers in brackets represent the % of the drainage catchment treated by the proposed solution).	Step 3 Annual Average Concentration related to EQS Compliance (ABC for Copper = 0.0µg/l): EQS Copper = 1.0µg/l and Zinc = 10.9µg/l		Step 3 Acute Soluble Copper & Zinc Number of exceedances per year (RST exceedance limits in brackets)				Step 3 Sediment Bound Pollutants (Pass / Fail)
				Copper (µg/l)	Zinc (µg/l)	Copper RST24 (2)	Copper RST6 (1)	Zinc RST24 (2)	Zinc RST6 (1)	
S3 - OU09	Pass	Domsey Brook d/s	Attenuation Pond	0.03	0.13	0.00	0.00	0.00	0.00	Pass (Alert D/S structure)
S3 - OU10	Pass	Domsey Brook d/s	Filter Drain (36%) & Attenuation Pond	0.16	0.52	0.20	0.00	0.00	0.00	Pass
S3 - OU17	Fails Cu RST24 and Cu RST6	Roman River	Filter Drain (37%) & Attenuation Pond (90%)	0.59	1.89	1.80	0.30	0.00	0.00	Pass
S3 - OU18	Pass	Roman River	Online Storage	0.29	0.94	0.80	0.00	0.00	0.00	Pass
S3 - OU19	Pass	Domsey Brook d/s	Filter Drain (15%) & Attenuation Pond	0.01	0.03	0.00	0.00	0.00	0.00	Pass
S3 - OU26B	Pass	Ordinary Watercourse 38	Attenuation Pond	0.16	0.62	0.20	0.00	0.00	0.00	Pass
S3 - OU30	Pass (Tier 2)	Domsey Brook u/s	Filter Drain (57%) & Cascading Attenuation Pond with two basins	0.49	1.65	0.90	0.10	0.00	0.00	Pass

Outfall Number	Step 2 assessment (pre-mitigation) result (Pass (all aspects) or details of failure)	Receiving Watercourse	Embedded Mitigation proposed (numbers in brackets represent the % of the drainage catchment treated by the proposed solution).	Step 3 Annual Average Concentration related to EQS Compliance (ABC for Copper = 0.0µg/l): EQS Copper = 1.0µg/l and Zinc = 10.9µg/l		Step 3 Acute Soluble Copper & Zinc Number of exceedances per year (RST exceedance limits in brackets)				Step 3 Sediment Bound Pollutants (Pass / Fail)
				Copper (µg/l)	Zinc (µg/l)	Copper RST24 (2)	Copper RST6 (1)	Zinc RST24 (2)	Zinc RST6 (1)	
S3 - OU30A	Pass (Tier 2)	Domsey Brook u/s	Filter Drain (54%) & Cascading Attenuation Pond with two basins & Vegetated outfall	0.41	1.39	0.70	0.10	0.00	0.00	Pass

*S2 – OU17 has been assessed as discharging to the existing drainage network with a Q_{95} of 0.001m^3/s used in the assessment. It is believed the existing drainage network (the total catchment of which includes areas beyond the proposed scheme which have not been determined) discharges to the River Blackwater and thus the results presented here represent the worst-case for the proportion of the drainage catchment impacted by the proposed scheme. S2 – OU17 is an existing drainage catchment (with no treatment) which will have its catchment size reduced as the majority of the existing S2 – OU17 catchment will become part of S2 – OU18 drainage catchment which does provide for some treatment.

Table 4.3 HEWRAT routine runoff cumulative outfalls results for soluble impacts at Step 3 (non-low flow watercourses)

Outfall Number	Step 2 assessment (pre-mitigation) result (Pass (all aspects) or details of failure)	Receiving Watercourse	Mitigation proposed	Step 3 Annual Average Concentration related to EQS Compliance (ABC for Copper = 0.0µg/l): EQS Copper = 1.0µg/l and Zinc = 10.9µg/l		Step 3 Soluble Copper & Zinc Number of exceedances/year (RST limits in brackets)			
				Copper (µg/l)	Zinc (µg/l)	Copper RST24 (2)	Copper RST6 (1)	Zinc RST24 (2)	Zinc RST6 (1)
S1 - OU12, OU10, OU10A, OU11	Fails Cu RST24	Boreham Brook	Filter Drains, Passive Treatment, Attenuation Pond	0.38	1.25	0.80	0.20	0.00	0.00
S1 - OU17 & OU18, OU15, OU13	Pass	River Ter	Filter Drains, Passive Treatment, Attenuation Pond	0.20	0.58	0.50	0.00	0.00	0.00
S2 - OU04 & OU05	Pass	River Brain	Attenuation Pond and Online Storage	0.04	0.16	0.00	0.00	0.00	0.00
S2 - OU24 + OU24A[1]	Pass	Rivenhall Brook	Filter Drains, Passive Treatment, Attenuation Pond	0.06	0.12	0.00	0.00	0.00	0.00

Outfall Number	Step 2 assessment (pre-mitigation) result (Pass (all aspects) or details of failure)	Receiving Watercourse	Mitigation proposed	Step 3 Annual Average Concentration related to EQS Compliance (ABC for Copper = 0.0µg/l): EQS Copper = 1.0µg/l and Zinc = 10.9µg/l		Step 3 Soluble Copper & Zinc Number of exceedances/year (RST limits in brackets)			
				Copper (µg/l)	Zinc (µg/l)	Copper RST24 (2)	Copper RST6 (1)	Zinc RST24 (2)	Zinc RST6 (1)
S2 - OU24 + OU24A + OU15G[1]	Fails Cu RST24	Rivenhall Brook	Filter Drains, Passive Treatment, Attenuation Pond	0.49	1.71	1.50	0.20	0.00	0.00
S2 – OU18 + OU27 + OU19	Pass	River Blackwater	Filter Drain, Retention Ponds, Passive Treatment	0.01	0.04	0.00	0.00	0.00	0.00
S3 - OU01 & OU05[1]	Pass	River Blackwater	Filter Drains & Attenuation Pond	0.01	0.04	0.00	0.00	0.00	0.00
(S3 - OU02, OU05, OU01) + (S2 - OU18 & OU19)[1]	Pass	River Blackwater	Filter Drains, Passive Treatment, Attenuation Pond	0.03	0.11	0.00	0.00	0.00	0.00
S3 - OU08, OU19, OU09, OU10[1]	Fails Cu RST24	Domsey Brook d/s	Filter Drains & Attenuation Ponds	0.29	1.06	0.70	0.00	0.00	0.00

Outfall Number	Step 2 assessment (pre-mitigation) result (Pass (all aspects) or details of failure)	Receiving Watercourse	Mitigation proposed	Step 3 Annual Average Concentration related to EQS Compliance (ABC for Copper = 0.0µg/l): EQS Copper = 1.0µg/l and Zinc = 10.9µg/l		Step 3 Soluble Copper & Zinc Number of exceedances/year (RST limits in brackets)			
				Copper (µg/l)	Zinc (µg/l)	Copper RST24 (2)	Copper RST6 (1)	Zinc RST24 (2)	Zinc RST6 (1)
S3 - OU08A, OU08, OU19, OU09[1]	Fails Cu RST24	Domsey Brook d/s	Filter Drains & Attenuation Ponds	0.27	0.97	0.70	0.00	0.00	0.00
S3 - OU17 & OU18	Fails Cu RST24, Cu RST6 and Cu EQS	Roman River	Filter Drains, Online Storage & Attenuation Pond	0.76	2.46	3.90	0.70	0.10	0.00
S3 - OU30A, OU30	Fails Cu RST24, Cu RST6 and Cu EQS	Domsey Brook u/s	Filter Drains, Attenuation Ponds & Vegetated outfall	0.69	2.29	1.80	0.10	0.00	0.00

[1] To identify whether outfalls are within 1km of each other, measurements have started from the furthest downstream outfall. Therefore, some outfalls appear more than once and are subject to separate cumulative assessments.

4.3.7 Table 4.4 presents the results from the cumulative assessments associated with potential sediment impacts (i.e. all outfalls included in the assessments are located within 100m of each other). The receiving watercourse are shown in Figure 14.1.3 in Annex G.

Table 4.4 HEWRAT routine runoff cumulative outfalls results for sediment impacts

Outfall Number	Receiving Watercourse	Mitigation proposed	Step 3 Sediment Bound Pollutants (Pass /Fail)
S1 - OU12, OU10, OU10A, OU11	Boreham Brook	Filter Drains, Passive Treatment, Attenuation Pond	Pass
S2 - OU04 & OU05	River Brain	Attenuation Pond and Online Storage	Pass
S2 - OU24 & OU24A	Rivenhall Brook	Filter Drains, Passive Treatment, Attenuation Pond	Pass (Alert D/S structure)
S3 - OU01 & OU05	River Blackwater	Filter Drains & Attenuation Pond	Pass

4.4 Step 2 and 3 single outfall assessment results

4.4.1 Of the 31 single outfalls assessed to non-low flow watercourses 26 pass all DMRB LA 113 standards (RST24 and RST6 for copper and zinc, EQS for copper and zinc and chronic sediment impact) at the Step 2 stage of the assessment (i.e. without the proposed mitigation). The 26 comprise of 19 existing outfalls and seven new outfalls. For these existing outfalls any treatment proposed is a betterment.

4.4.2 For the five single outfalls which did not pass the HEWRAT assessments at Step 2 (i.e. without consideration of mitigation) the magnitude of impact as a result of the failures recorded varies. Details of the aspects of HEWRAT assessments that were failed at Step 2 and what magnitude of impact these results represent (as described in Table 7.1) is summarised as follows:

- One proposed National Highways outfall (S2 – OU15G) failed copper RST24, resulting in a minor magnitude impact
- One proposed ECC outfall (S2 – OU15H) failed for sediment bound pollutants only resulting in a minor magnitude impact
- One existing National Highways outfall (S3 – OU17) failed copper RST24 and copper RST6, resulting in a minor magnitude impact
- Two proposed National Highways outfalls (S3 – OU30 and 30A) failed for copper RST24, copper RST6, copper EQS (based upon HEWRAT results alone) and Sediment bound pollutants, resulting in a major magnitude impact

4.4.3 When the proposed mitigation is considered (i.e. at Step 3), Table 4.2 shows that all of the 31 individually assessed outfalls pass all DMRB LA 113 standards (RSTs, EQS and sediments).

4.5 Step 2 and 3 cumulative outfall assessment results

4.5.1 Table 4.3 also shows that six of the 12 cumulative assessments pass all DMRB LA 113 standards (RSTs, EQS and sediment) at Step 2 of the assessment process (i.e. without the proposed mitigation).

4.5.2 For the six cumulative outfalls which did not pass the HEWRAT assessments at Step 2 the magnitude of impact as a result of the failures recorded varies. Details of the aspects of HEWRAT assessments that were failed at Step 2 and what magnitude of impact these results represent (as detailed in Table 7.1) is summarised as follows:

- Two cumulative assessments (each comprising of two National Highways outfalls) failed for copper RST24, copper RST6 and copper EQS resulting in a major magnitude impact
- Four cumulative assessments (each containing three or four outfalls) failed for copper RST24 resulting in a minor magnitude impact. The four assessments include a combination of National Highways and ECC outfalls and each a combination of new and existing outfalls.

4.5.3 After proposed mitigation is considered at Step 3 an additional five cumulative assessments pass all aspects of HEWRAT, taking the total number of cumulative assessments to achieve all standards to 11 out of 12. The one remaining cumulative assessment that fails (S3 – OU17 and 18, both existing National Highways assets), fails the copper RST24, which results in a minor magnitude impact. The proposed mitigation for this cumulative assessment includes a filter drain for part of the catchment and pond for outfall S3_OU17. Due to site constraints only online storage can be provided for S3_OU18 which does not provide any treatment for water quality. The discharge rate for the pond for outfall S3_OU17 will be limited to 5 l/s. The A12 mainline catchment portion that extends beyond the proposed attenuation pond and the discharge from outfall S3_OU18 will be restricted by orifice plate flow control devices. The storage to be provided and the limitations upon discharge rates for both catchments will potentially reduce peak flows and thus reduces the likelihood that the RST24 would be exceeded.

5 Groundwater assessment

5.1 Introduction

5.1.1 This section presents the groundwater assessment for the routine runoff required as part of the A12 to A120 widening scheme as required by the Design Manual for Roads and Bridges (DMRB) LA 113.

5.1.2 Based on the current design, there are no direct discharge to the ground proposed as part of the A12 to A120 widening scheme.

5.1.3 However, there are 61 individual outfall locations where the receiving watercourses are anticipated to have Q_{95} flow of less than 1l/s due to their proximity to the watercourse's source, or where they may be dry for some periods of the year. There are also 17 locations where there may be cumulative effects from two or more of these individual outfalls.

5.1.4 No information is available regarding whether the channels are lined or unlined so, in adherence with the precautionary principle, it is assumed they are unlined and hence this assessment is required.

5.1.5 The outfall locations and receiving watercourses which have been assessed are presented in Figure 14.1.2 in Annex G.

5.2 Methodology

5.2.1 A semi-quantitative groundwater risk assessment has been carried out for the Proposed Scheme in accordance with Appendix C of DMRB LA 113 focussing on the identified receiving watercourses anticipated to have Q_{95} flow of less than 1 l/s.

5.2.2 The current drainage design assumes full attenuation, with no allowance for infiltration from Sustainable Drainage System (SuDS) features such as swales, filter drains and attenuation ponds. For the purpose of this assessment, it is assumed that all flow will pass through the SuDS features to be discharged to watercourses via outfalls. The receiving watercourses may act as soakaways allowing infiltration to ground. As the detailed design evolves, this may change, and assessment of the SuDS features may be required.

5.2.3 The methodology is based on that described in Appendix C of DMRB LA 113 (Highways England, March 2020a), which should be referred to for further details. A source-pathway-receptor (SPC) conceptual site model (CSM) is used as the basis for the assessment.

5.2.4 The source comprises of pollutants contained within road runoff that enter the ground, the pathway is the drainage system and unsaturated zone, and the receptor is groundwater and associated groundwater users, receiving surface waters and the environment.

5.2.5 As part of Appendix C of DMRB LA 113, the source is defined by the following parameters:

- Traffic flow, expressed as an annual average daily traffic (AADT) flow

- Annual average rainfall depth (mm)
- Drainage area ratio. This is the ratio of the drainage area of the road to the active surface area of the infiltration device

5.2.6 The key factors affecting the persistence and movement of pollutants through the pathway are as follows:

- Infiltration method – either a 'continuous' shallow linear system such as an unlined ditch, a 'regional' shallow system such as an infiltration basin, or a 'point' system such as a deep soakaway
- Unsaturated zone thickness, i.e. depth to water table
- Flow type – whether groundwater flow is dominated by intergranular or fracture flow
- Unsaturated zone clay content, expressed as % clay minerals
- Organic carbon, expressed as % soil organic matter (SOM)
- Unsaturated zone soil pH

5.2.7 Each source and pathway parameter is assigned a numerical weighting factor to represent its relative influence on the overall risk to groundwater.

5.2.8 The value (or type, in the case of infiltration method and flow type) of each parameter will fall into one of three risk levels (low, medium, high), with an associated risk factor (1, 2, 3). The risk factor is then multiplied by the weighting factor to provide a score for each parameter. The scores for all parameters are then added together to provide an overall risk score. The overall risk scores relate to an overall risk to groundwater as follows:

- Low risk: Overall risk score less than 150
- Medium risk: Overall risk score 150 to 250
- High risk: Overall risk score greater than 250

5.2.9 Traffic flow is based on the results of traffic flow modelling provided by the Jacobs traffic modelling team. The modelling results indicate that the AADT flow will be less than or equal to 50,000 vehicles per day.

5.2.10 Annual average rainfall depth was taken from Ipswich, approximately 19 km north-east of the Proposed Scheme, which has a standardised annual average rainfall (SAAR) of 550 mm.

5.2.11 All receiving watercourses are assumed to be unlined ditches and are, therefore, categorised as continuous shallow linear infiltration systems.

5.2.12 Groundwater levels were based on the results from ground investigation, using the highest groundwater level or the depth to water strikes where no monitoring information was available. Further information on groundwater levels is presented in the Groundwater Assessment (Appendix 14.4 of the Environmental Statement [TR010060/APP/6.3]).

5.2.13 Groundwater flow within the superficial aquifers is likely to be dominated by intergranular flow.

5.2.14 Limited clay content, organic carbon content and pH of the unsaturated zone was available from the ground investigation but this was used where possible. Where data was not available, reasonable values have been chosen based on general lithological descriptions of the superficial strata, taking conservative values where necessary.

5.2.15 Where medium or high risks have initially been identified, the results from the routine runoff assessments have been used to screen the predicted Step 2 and Step 3 metal concentrations against suitable water quality standards protective of groundwater and groundwater receptors. As the receptors are all low flow features (<0.0011l/s) with negligible dilution it was considered suitable to use the Step 2 (without mitigation) and Step 3 (including embedded mitigation) results in the assessment.

5.2.16 Research undertaken by National Highways in collaboration with the Environment Agency concluded that dissolved Polyaromatic Hydrocarbons (PAHs) are not classified as ‘significant pollutants’ to groundwater. PAHs are strongly absorbed to the organic fraction, and do not penetrate deeply into most soils, therefore limiting leaching to groundwater. The fate of PAHs in the unsaturated zone was reported by the Highways Agency in 2010 (Fate of Highway Contaminants in the Unsaturated Zone. Final Synthesis Report, March 2010). It was concluded that in porous media, residual concentrations of these organic compounds would be reduced to below the limit of laboratory analytical detection within approximately 0.5m depth of the unsaturated zone. Hence discernible concentrations entering groundwater are considered unlikely from the proposed scheme and therefore PAHs are not considered to be contaminants of concern for the routine runoff assessment for groundwater.

5.2.17 The pertinent groundwater receptors are considered to be either private or licenced groundwater abstraction wells or surface water features which are groundwater fed. Details of the groundwater receptors are provided in the Groundwater Assessment (Appendix 14.4 of the Environmental Statement [TR010060/APP/6.3]).

5.3 Assumptions and limitations

5.3.1 The following assumptions and limitations were noted for the assessment:

- No measured data regarding flows within the channels is available to determine if the groundwater risk assessment is appropriate for each discharge. Some channels may have higher flow and hence this is a conservative assumption.
- The drainage strategy is in draft form, changes to the drainage strategy may occur during detailed design stage.
- This assessment assumes no infiltration to ground from SuDS features prior to discharge via outfalls and these features have not been included in the assessment. As the detailed design evolves, assessment of infiltration from SuDS features may be required.

- Limited ground investigation data is available at the individual outfall locations and organisational judgement has been used to extrapolate groundwater levels, lithologies and physiochemical properties. Ground Investigation data will be reviewed at detailed design stage and should groundwater conditions be proved to be different to those assumed in this assessment, the assessment should be revisited.
- The ratio of the drainage area in the assessment was set at the default value of >50 and <150 due to the catchment details and length of low flow catchment not being available at the time of the assessment. Amended to the more conservative value does not change the outcome of the assessment.
- The assumptions and limitations listed in the Environmental Statement (Chapter 14: Road drainage and the water environment, [TR010060/APP/6.1]) apply to the assessments described in this section.

5.4 Results and impact assessment

Semi-quantitative assessment

5.4.1 The details and results of the HEWRAT groundwater assessment are provided in Table H.1 in Annex H. The results indicate:

- 13 of the single outfalls pose a low risk to groundwater quality and are not considered further. These are S1-OU7A, S2-OU11, S2-OU14, S3-OU13, S3-OU32, S3-OU33 and the seven proposed outfalls from attenuation ponds along Inworth Road.
- The remaining 48 single outfalls all were given a medium risk and hence were taken to further assessment.
- One of the cumulative outfall locations has been assessed to pose a low risk to groundwater quality with all the other 16 locations posing a medium risk. The low risk location is associated with a worst case assumed cumulative outfall associated with all the Inworth Road attenuation ponds.

Detailed assessment

5.4.2 Further assessment of the HEWRAT results was undertaken to screen the predicted metal concentrations in the runoff against water quality standards both prior to and following the embedded mitigation measures. The screening used the lowest of available Environmental Quality Standards and Drinking Water Standards.

5.4.3 The detailed results are presented in Table H.2 in Annex H.

5.4.4 The results indicated that:

- Prior to mitigation, 12 single outfall locations fail the EQS screen for copper concentrations and one location for zinc.
- Prior to mitigation, nine cumulative outfall locations fail the EQS screen for copper and none for zinc.

- Post-mitigation, only one single outfall location (S2-OU8) and one cumulative outfall location (S2-OU15A, OU14 and OU15E) marginally fail the copper EQS screen.
- However, when compared to M-BAT criteria and drinking water standards, all locations pass the screening pre and post mitigation.

Groundwater abstractions

5.4.5 Although none of the outfall locations have pre or post mitigation concentration in excess of drinking water standards for the compounds assessed, a review of the outfall locations and licenced and private groundwater abstraction was undertaken to assess the potential risk for groundwater quality impacts on groundwater users. Details on the groundwater abstractions are presented in Appendix 14.4 [TR010060/APP/6.3] and Figure 14.3 [TR010060/APP/6.2] of the Environmental Statement.

5.4.6 Figure 14.3 [TR010060/APP/6.2] shows that the outfalls in Table 5.1 are located within default source protection zones (SPZs) associated with groundwater abstractions.

Table 5.1 Assessment of groundwater abstractions near outfalls to low flow streams

Groundwater abstraction	Outfall location	Source Protection Zone	Comment
PGA-1	S1-OU13 and S1-OU5	Outer	Outfall to stream location with no groundwater infiltration.
PGA-3 / LGA-3	S1-OU23	Outer	Outfall to stream location with no groundwater infiltration.
	S1-OU24A	Outer	Predicated pre and post concentrations below EQS and DWS. Negligible risk.
PGA-5	S2-OU15A	Outer	Predicated post mitigation concentrations below DWS and EQS. Negligible risk.
PGA-7	S2-OU19	Outer	Outfall to stream location with no groundwater infiltration.

5.5 Impact assessment

5.5.1 In accordance with Table 3.71 in DMRB LA 113, a medium risk of pollution to groundwater from routine runoff is considered to represent a moderate effect on groundwater quality where run-off discharge is to watercourses with low flow conditions.

5.5.2 However, considering the detailed assessment and the embedded mitigation measures (treatment trains for each outfall) the residual risk of pollution is considered to be negligible to groundwater and groundwater receptors.

5.5.3 On this basis, the residual significance of impact on groundwater quality from the outfall locations is considered to be Neutral.

5.5.4 Groundwater quality risks on groundwater abstractions as a result of routine runoff are generally negligible. Further detail in the Groundwater Assessment (Appendix 14.4 of the Environmental Statement [TR010060/APP/6.3]) covers water quality risks to groundwater abstractions during construction activities and includes the implementation of some mitigation measures.

5.5.5 Groundwater quality risks to groundwater dependant terrestrial ecosystems (GWDTE) associated with the outfalls to low flow streams are also considered to be negligible. Further details in Groundwater Assessment (Appendix 14.4 of the Environmental Statement [TR010060/APP/6.3]) cover general water quality risks to GWDTE.

5.6 Summary

5.6.1 A simple assessment of the impact that routine runoff may have on groundwater quality has been completed in accordance with the method described in Appendix C of DMRB LA 113 (Highways England, March 2020a). This assessment shows that many of the outfalls pose a medium risk to groundwater quality. However, contaminant treatment measures included in the drainage design, which are not considered in the DMRB methodology, are considered to reduce the risk to groundwater quality to low. Accordingly, no significant effects on groundwater quality are predicted.

6 Accidental spillage risk

6.1 Introduction and approach

6.1.1 This section presents the results (Table 6.1 and Table 6.2) of the HEWRAT spillage risk assessment for the proposed scheme for both surface water and groundwater, as detailed in the methodology for spillage risk assessments within DMRB LA 113. With reference Table 6.1, an annual probability of a serious pollution incident occurring of less than 0.5% (return period of >200 years) is deemed to have a negligible magnitude of impact. This magnitude of impact, regardless of value of receptor (refer to Table 6.1), always results in a residual effect that is not environmentally significant (slight or neutral), in accordance with DMRB LA 104 (Highways England et al., 2020b).

6.1.2 Where outfalls deemed part of the proposed scheme, are not documented in Table 6.1 (i.e. outfalls in design section 1: OU19C, OU19C1; design section 3: OU13, OU14, OU15B, OU15C, OU19, OU20, OU22, OU27, OU27A, OU28, OU31 and OU32), this indicates the roads within the drainage catchments for these outfalls have not been included in the traffic model due to them being very low trafficked roads, most commonly serving isolated properties.

6.1.3 All catchments which have not been included in the traffic model, contain SuDS mitigation, either in the form of a filter drain and attenuation pond, attenuation pond or a swale. As such, it is confidently anticipated the risk of a serious spillage risk occurring, within these catchments, would be well below environmentally significant thresholds. If any outfalls were considered to be within 1km of a protected they would be flagged and subject to a lower acceptable limit threshold (i.e. return period of 200 years rather than 100 years). However, based on assessment previously outlined in this appendix, it has been concluded for surface water quality, no applicable protected sites have been identified.

6.2 Results

6.2.1 Table 6.1 shows that for all outfalls throughout the proposed scheme, spillage risk assessment results are deemed to be within acceptable limits in accordance with DMRB LA 113, even when compared to the most sensitive annual probability threshold (0.5% or return period >200 years). All drainage catchments, except two (S1 OU01 = 515 years, S3 OU17 = 873 years), have an estimated return period of a serious spillage risk occurring of 1000 years or more. All results represent a negligible environmental impact.

Table 6.1 Spillage risk assessment results for single outfalls

Outfall Number	Surface Water Receiving watercourse	Return Period (years) of Spillage	Does it meet acceptable limits? (Return period >200 years)	Overall Environmental Significance
Design section 1 (S1) of the proposed scheme, beyond A12 Junction 18 to beyond A12 Junction 21				
OU01	River Chelmer	515	Yes	Not Significant
OU07	Ordinary Watercourse 2	14,781	Yes	Not Significant
OU07A	Ordinary Watercourse 2	2,846	Yes	Not Significant
OU10	Boreham Brook	48,746	Yes	Not Significant
OU10A	Boreham Brook	1,768,428	Yes	Not Significant
OU11	Boreham Brook	6,589	Yes	Not Significant
OU12	Boreham Brook	3,267	Yes	Not Significant
OU13	River Ter	1,932	Yes	Not Significant
OU14	Ordinary Watercourse 28	2,953	Yes	Not Significant
OU13A	Ordinary Watercourse 28	39,393	Yes	Not Significant
OU15	River Ter	10,935	Yes	Not Significant
OU17 & OU18	River Ter	1,611	Yes	Not Significant
OU19	Ordinary Watercourse 7	5,990	Yes	Not Significant
OU23	Ordinary Watercourse 32	1,066	Yes	Not Significant
OU23C	Ordinary Watercourse 32	47,828	Yes	Not Significant
OU23D	Ordinary Watercourse 32	7,684	Yes	Not Significant
OU24A	Ordinary Watercourse 32	45,674	Yes	Not Significant
OU24B	Ordinary Watercourse 32	14,633	Yes	Not Significant

Outfall Number	Surface Water Receiving watercourse	Return Period (years) of Spillage	Does it meet acceptable limits? (Return period >200 years)	Overall Environmental Significance
Design section 2 (S2) of the proposed scheme, beyond A12 Junction 21 to beyond A12 Junction 23				
OU03	Ordinary Watercourse 9	18,387	Yes	Not Significant
OU04	River Brain	4,854	Yes	Not Significant
OU05	River Brain	7,801	Yes	Not Significant
OU08	River Blackwater	2,362	Yes	Not Significant
OU09	Ordinary Watercourse 10	4,026	Yes	Not Significant
OU09A	Ordinary Watercourse 10	36,775	Yes	Not Significant
OU10	Ordinary Watercourse 10	7,286	Yes	Not Significant
OU11	Ordinary Watercourse 11	5,250	Yes	Not Significant
OU14	Ordinary Watercourse 12a	16,507	Yes	Not Significant
OU15A	Ordinary Watercourse 12a	3,430	Yes	Not Significant
OU15C	Ordinary Watercourse 13	3,122	Yes	Not Significant
OU15C1	Ordinary Watercourse 15a	20,680	Yes	Not Significant
OU15D	Ordinary Watercourse 13	86,968	Yes	Not Significant
OU15D1	River Blackwater	363,683	Yes	Not Significant
OU15E	Ordinary Watercourse 12a	10,340	Yes	Not Significant
OU15F	Rivenhall Brook	64,787	Yes	Not Significant
OU15G	Ordinary Watercourse 17	2,072	Yes	Not Significant
OU15H	River Blackwater	30,456	Yes	Not Significant
OU18	River Blackwater	53,412	Yes	Not Significant

Outfall Number	Surface Water Receiving watercourse	Return Period (years) of Spillage	Does it meet acceptable limits? (Return period >200 years)	Overall Environmental Significance
OU19	Rivenhall Brook	4,973	Yes	Not Significant
OU24	Rivenhall Brook	28,592	Yes	Not Significant
OU24A	Ordinary Watercourse 17	62,815	Yes	Not Significant
OU26	Unnamed Ditch	285,058,528,930	Yes	Not Significant
OU27	Ordinary Watercourse 11	509,650,097,178	Yes	Not Significant
Design section 3 (S3) of the proposed scheme, beyond A12 Junction 23 up to A12 Junction 26				
OU01	River Blackwater	3,128	Yes	Not Significant
OU02	River Blackwater	2,385	Yes	Not Significant
OU03	Ordinary Watercourse 18	8,772,866	Yes	Not Significant
OU05	Ordinary Watercourse 21	12,040,271	Yes	Not Significant
OU06	River Blackwater	2,871,436	Yes	Not Significant
OU07A	Ordinary Watercourse 21a	1,291,243	Yes	Not Significant
OU08	Ordinary Watercourse 21a	4,940	Yes	Not Significant
OU08A	Domsey Brook d/s	3,514	Yes	Not Significant
OU08B&D	Unnamed Ditch (ultimately Domsey Brook d/s)	7,051	Yes	Not Significant
OU08C	Existing Drainage (Inworth Rd)	138,847	Yes	Not Significant
OU08E	Existing Drainage (Inworth Rd)	138,847	Yes	Not Significant
OU09	Domsey Brook d/s	15,415	Yes	Not Significant
OU10	Domsey Brook d/s	2,755	Yes	Not Significant
OU15	Ordinary Watercourse 26	9,075	Yes	Not Significant

Outfall Number	Surface Water Receiving watercourse	Return Period (years) of Spillage	Does it meet acceptable limits? (Return period >200 years)	Overall Environmental Significance
OU15A	Ordinary Watercourse 36	7,127	Yes	Not Significant
OU16	Ordinary Watercourse 36	9,695	Yes	Not Significant
OU17	Roman River	873	Yes	Not Significant
OU18	Roman River	3,223	Yes	Not Significant
OU21	Ordinary Watercourse 23	3,531	Yes	Not Significant
OU23	Ordinary Watercourse 23	354,890	Yes	Not Significant
OU24	Ordinary Watercourse 23	24,064	Yes	Not Significant
OU26	Ordinary Watercourse 37	5,112	Yes	Not Significant
OU26A	Ordinary Watercourse 37	2,024	Yes	Not Significant
OU26B	Ordinary Watercourse 38	14,587	Yes	Not Significant
OU29	Unnamed Ditch	56,464	Yes	Not Significant
OU30	Domsey Brook u/s	2,018	Yes	Not Significant
OU30A	Domsey Brook u/s	2,059	Yes	Not Significant
OU33	Ordinary Watercourse 42	32,596	Yes	Not Significant

6.2.2 The receiving WFD groundwater body as defined as the Essex Gravels in the study area. The results of the spillage assessment above also demonstrate a negligible environmental impact to groundwater based on the estimated return periods.

6.2.3 Table 6.2 shows the cumulative spillage risk assessments for surface water undertaken for all outfalls discharging to the same watercourse regardless of distance from each other. Similar to individual spillage risk assessments, results show all cumulative assessments are deemed to be within acceptable limits in accordance with DMRB LA 113, even when compared to the most sensitive annual probability threshold (0.5% or return period >200 years) and therefore represent an insignificant environmental impact.

6.2.4 Of the 24 cumulative assessments undertaken for spillage risk, five were calculated with a risk below 1000 years, with the lowest return period (527 years) associated with outfalls discharging to Domsey Brook.

Table 6.2 Spillage risk assessment results for surface water for cumulative outfalls for each watercourse.

Outfalls	Receiving Watercourse	Return Period (years) of Spillage	Does it meet acceptable limits? (Return period >200 years)	Overall Environmental Significance
Design section 1 (S1) of the proposed scheme, beyond A12 Junction 18 to beyond A12 Junction 21				
OU7, OU7A	Ordinary Watercourse 2	2,387	Yes	Not Significant
OU10, OU10A, OU11, OU12	Boreham Brook	2,088	Yes	Not Significant
OU13, OU15	River Ter	813	Yes	Not Significant
OU14, OU13A	Ordinary Watercourse 28	859	Yes	Not Significant
OU19, OU19C, OU19C1	Ordinary Watercourse 7	5,990	Yes	Not Significant
OU23, OU23C, OU23D, OU24A, OU24B	Ordinary Watercourse 32	848	Yes	Not Significant
Design section 2 (S2) of the proposed scheme, beyond A12 Junction 21 to beyond A12 Junction 23				
OU4, OU5	River Brain	2,992	Yes	Not Significant
OU9, OU9A, OU10	Ordinary Watercourse 10	2,422	Yes	Not Significant
OU14, OU15A, OU15E	Ordinary Watercourse 12a	2,228	Yes	Not Significant
OU15C, OU15D	Ordinary Watercourse 13	3,014	Yes	Not Significant
OU15D1, OU18, OU19	River Blackwater	4,494	Yes	Not Significant
OU15G, OU24, OU24A	Rivenhall Brook	1,875	Yes	Not Significant
OU15H, OU26	Ordinary Watercourse 17	30,456	Yes	Not Significant

Outfalls	Receiving Watercourse	Return Period (years) of Spillage	Does it meet acceptable limits? (Return period >200 years)	Overall Environmental Significance
Design section 3 (S3) of the proposed scheme, beyond A12 Junction 23 up to A12 Junction 26				
OU1, OU5	River Blackwater	3,127	Yes	Not Significant
OU2, OU4	Ordinary Watercourse 21	2,385	Yes	Not Significant
OU6, OU7A, OU14,	Ordinary Watercourse 21a	890,706	Yes	Not Significant
OU8, OU8A, OU9, OU10, OU19, OU20, OU30, OU30A	Domsey brook	527	Yes	Not Significant
OU15, OU15B, OU15C	Ordinary Watercourse 26	9,075	Yes	Not Significant
OU15A, OU16	Ordinary Watercourse 36	4,108	Yes	Not Significant
OU17, OU18,	Roman River	687	Yes	Not Significant
OU21, OU22, OU23, OU24	Ordinary Watercourse 23	3,053	Yes	Not Significant
OU26, OU26A,	Ordinary Watercourse 37	1,450	Yes	Not Significant
OU27, OU27A, OU28	Ordinary Watercourse 39	no traffic data	Yes	Not Significant

7 Water quality residual significant effects

7.1 Significance methodology

7.1.1 DMRB LA 113 (Highways England et al., 2020a) documents the typical examples that can be used for identifying the magnitude of impacts related to surface water quality. Table 7.1 presents these examples which is dependent upon the HEWRAT results for routine runoff and accidental spillage risk. The magnitude of an impact (selected from Table 7.1) and the value of a receptor are combined to produce the significance of effect (Table 7.2) which is used to determine the overall environmental impact in line with DMRB LA 104 (Highways England et al., 2020b). The value of receptors are determined based upon typical examples presented in DMRB LA 113 (Table 3.70 within DMRB LA 113) and this is described further in the Environmental Statement (Chapter 14: Road drainage and the water environment [TR010060/APP/6.1]).

Table 7.1 Routine runoff typical examples for establishing the magnitude of impact (taken from Table 3.71 in DMRB LA 113).

Magnitude of impact	Typical Examples for routine runoff and Spillage Risk
Major adverse	Failure of both acute-soluble **and** chronic-sediment related pollutants in HEWRAT and compliance failure with EQS values. Calculated risk of pollution from a spillage ≥2% annually (spillage assessment)
Moderate adverse	Failure of **both** acute-soluble and chronic-sediment related pollutants in HEWRAT but compliance with EQS values. Calculated risk of pollution from spillages ≥1% annually and <2% annually.
Minor adverse	Failure of **either** acute soluble or chronic sediment related pollutants in HEWRAT. Calculated risk of pollution from spillages ≥0.5% annually and <1% annually.
Negligible	No risk identified by HEWRAT (pass both acute-soluble and chronic-sediment related pollutants). Risk of pollution from spillages <0.5%

Table 7.2 Significance matrix (taken from Table 3.8.1 in DMRB LA 104)

Magnitude / Value of Receptor	No change	Negligible	Minor	Moderate	Major
Very High	Neutral	Slight	Moderate / Large	Large / Very Large	Very Large
High	Neutral	Slight	Slight / Moderate	Moderate / Large	Large / Very Large
Medium	Neutral	Neutral / Slight	Slight	Moderate	Moderate / Large
Low	Neutral	Neutral / Slight	Neutral / Slight	Slight	Slight / Moderate

7.1.2 With reference to Table 7.2, resulting significance of effects that are considered to be ‘Slight’ or ‘Neutral’ are considered to be insignificant. Conversely, significant effects typically comprise residual effects that are within the ‘Moderate’, ‘Large’ or ‘Very Large’ categories. DMRB LA 104 states where there is a choice between two significance categories, evidence should be provided to support the reporting of a single significance category.

7.2 Residual significance of routine runoff results

7.2.1 The residual significance of effects for all assessments are provided in Table F.1 and Table F.2 in Annex F. As all outfalls pass the spillage risk assessments to surface and groundwaters the significance of effect has been influenced by the routine runoff results. The significance of effect has been based upon the magnitude of impact as determined for the low flow watercourses using the groundwater assessment results (Annex H) and for the remaining watercourses using the surface water results (Annex F). With mitigation all outfalls assessed as surface waters pass for sediment-bound pollutant impacts. Based upon the surface water results all single and cumulative outfalls pass the EQS for copper and zinc with the proposed mitigation. The residual effect has been influenced by the residual acute failures (i.e. RSTs) for copper and zinc for the outfalls assessed to surface waters (i.e. non low flow watercourses). With the proposed mitigation all 31 individual surface water outfalls pass resulting in no greater than a slight adverse effect. For the cumulative assessments, all 12 pass except one (S3_OU17 and S3_OU18) which results in a minor adverse impact. These outfalls discharge to the Roman River, a High value receptor. Based upon Table 3.8.1 in DMRB LA 104 this results in a Slight/Moderate effect. A Slight effect has been considered appropriate as the impact relates to a failure of the RST24 for copper, with the RST6 for copper and both RSTs for Zinc being within the thresholds.

7.2.2 As discussed in Section 3.5, for watercourses with low flows with the embedded mitigation measures (treatment trains for each outfall) the residual risk of pollution is considered to be negligible and the residual significance of effect for the receiving watercourses at these outfall locations is considered to be Neutral and this is presented in Table F.1 and Table F.2 in Annex F.

7.2.3 After the currently proposed mitigation measures are applied, no environmentally significant effects are reported for single or cumulative outfall assessments for both surface water and groundwater quality throughout the proposed scheme. Although not quantified for those outfalls that pass at Step 2 (pre mitigation) and for the existing outfall with no treatment where measures have been included to provide water quality treatment this will provide a betterment and will be a beneficial effect.

8 Conclusions

8.1.1 The water quality assessments have considered the impact of the proposed scheme in relation to pollution from routine runoff and accidental spillage risk, in accordance with the DMRB LA 113 standard.

8.1.2 Of the 92 total outfalls 31 have been assessed for impacts to surface waters. The remaining 61 have been assessed for impacts to groundwater. For the outfalls assessed to surface waters 12 cumulative assessments were undertaken for routine runoff using HEWRAT.

8.1.3 For the 31 individual surface water assessments, at Step 2, a total of 26 single outfalls passed all aspects of HEWRAT. After proposed mitigation was considered at Step 3, all 31 single outfalls passed all aspects of HEWRAT. As such, the overall significance of effect is no greater than slight, and non-environmentally significant when discharges are considered individually.

8.1.4 Of the 12 cumulative assessments to surface waters at Step 2, a total of 6 cumulative assessments passed all aspects of HEWRAT pre-mitigation. After proposed mitigation was considered at Step 3, a total of 11 cumulative outfalls passed all aspects of HEWRAT. The one outfall which did not pass all aspects, failed for short-term (i.e. acute) impacts of soluble copper (RST24). These results meant only a minor magnitude of impact was reported for this outfall and the subsequent overall significance of effect was slight and not environmentally significant.

8.1.5 Failure of copper EQS thresholds were recorded during simple level assessments using HEWRAT, without the inclusion of an ABC concentration. As such a detailed level assessment using M-BAT and including the ABC concentration for copper was undertaken which determined that when the bioavailability of the metal is considered that all outfalls achieve the relevant EQS prior to any mitigation being considered.

8.1.6 For the low flow watercourses, the groundwater risk assessments have indicated that using the HEWRAT groundwater tool on a semi-quantitative basis, the majority of the outfall locations to low flow watercourses could pose a medium risk to groundwater quality. However, when using the Step 2 and Step 3 results from HEWRAT for these outfalls the detailed assessment indicated that only one single outfall location (S2 - OU8) and one watercourse with potential cumulative effects (S2-OU15A, OU14 & OU15E) marginally fails the EQS threshold post-mitigation. The results at these locations were further screened against the M-BAT values (considered to be protective of surface waters) and drinking water standards (to be protective of groundwater uses). All the concentrations were below these values and consequently the overall residual significance of effects for all the outfalls to groundwater is not environmentally significant.

8.1.7 The spillage risk assessment results for the proposed scheme show that all outfalls meet the acceptable limits and potential impacts from accidental spillage risk to surface water and groundwater is deemed not to be environmentally significant.

8.1.8 After the currently proposed embedded mitigation measures are applied, effects are no greater than slight (not environmentally significant). As a result, the proposed scheme is not anticipated to cause a significant environmental effect to the water environment from routine runoff, in accordance with the DMRB LA 113 standard.

8.1.9 Results show many outfalls passed the HEWRAT routine runoff assessments at the Step 2 stage, prior to consideration of mitigation. However, measures that provide treatment have been included in these drainage catchments which provides a betterment for water quality compared to the existing situation, as currently there is no (or limited) mitigation provided. The enhanced water quality which is anticipated to be delivered from the proposed scheme will provide an overall betterment for water quality.

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Glossary, Abbreviations and symbols

Abbreviation/Term	Definition
AADT	Annual Average Daily Traffic
ABC	Ambient Background Concentration
AEP	Annual Exceedance Probability
Aquatic	Growing, living or found in water.
BFI	Baseflow Index The proportion of the flow in a watercourse made up of groundwater and discharges. Base flow sustains the watercourse in dry weather.
Bioavailable	This is the fraction of dissolved metal that has the potential to contribute to toxic effects in aquatic animals or plants as determined in accordance with the method, metals bioavailability assessment tool (M-BAT).
BioF	Bioavailability Factor
Ca	Calcium
CIRIA	Construction Industry Research and Information Association
Cu	Copper
DCO	Development Consent Order
DDMS	Highways England Drainage Data Management System
DF	Design Fix
DI	Deposition Index A dimensionless index value that considers the extent of sediment coverage on the stream bed.
DMRB	Design Manual for Roads and Bridges
DOC	Dissolved Organic Carbon
EA	Environment Agency (public body with responsibilities relating to the protection and enhancement of the environment in England and Wales)
ECC	Essex County Council
EIA	Environmental Impact Assessment
EQS	Environmental Quality Standard The maximum permissible concentration of a potentially hazardous chemical. It is used to assess the risk to the health of aquatic flora and fauna.
Environmental Statement	An Environmental Statement (sometimes shortened to ES) is an assessment of the likely significant environmental effects of any proposed scheme / development

Abbreviation/Term	Definition
GI	Ground Investigation
(Water) Hardness	Amount of dissolved calcium and magnesium in the water
Heavy Metals	Lead (Pb), Zinc (Zn), Copper (Cu), Chromium (Cr), Cadmium (Cd), Manganese (Mn), Iron (Fe), Nickel (Ni), and Cobalt (Co) – a group of ferrous and non-ferrous metals commonly known as heavy metals found in motorway or road surface runoff. Pb is a specific product of vehicle exhaust emissions from petrol driven engines, Zn is present in car tyres and motor vehicle components and Cu, Cr and Cd are released principally as corrosion products.
HEWRAT	Highways England Water Risk Assessment Tool
HGVs	Heavy Goods Vehicles
LNR	Local Nature Reserve
Mannings n	The effective channel roughness which is a function of channel velocity, flow area and channel slope. Vegetation can have a major influence on Manning's n and may account for marked seasonal variation in n. Channel irregularity may also increase n, as will sharp curvature in a channel.
M-BAT	UKTAG Rivers and Lakes Metal Bioavailability Assessment Tool
pH	'potential of hydrogen' or 'power of hydrogen') is a scale used to specify the acidity or basicity of an aqueous solution
PEIR	Preliminary Environmental Information Report (produced in preparation of an Environmental Statement)
PNEC / P_{NEC}	Predicted No Effect Concentration
Q_{95}	The flow equalled or exceeded in a watercourse 95% of the time
Reach	A length of watercourse between two confluences
RST	Runoff-specific threshold Time dependent (24 hour or six hour) soluble pollutant concentration above which adverse effects may be observed in aquatic fauna.
SSSI	Site of Special Scientific Interest
SuDS	Sustainable Drainage System
TSS	Total Suspended Solids
UKTAG	UK Technical Advisory Group
WER	Water Environment Regulations (2017)
WFD	Water Framework Directive
Zn	Zinc

Annex A DMRB LA 113 and HEWRAT methodology for routine runoff and spillage risk to surface waters

A.1 Routine runoff

A.1.1 A broad range of potential pollutants are associated with routine runoff from operational roads. There are a number of factors which influence both the pollutant concentrations in routine runoff and whether the runoff is likely to have an impact on the receiving water body. Site characteristics found to have some significant influence on pollutant concentrations were Annual Average Daily Traffic (AADT) Flows and climatic region. The potential impact of pollutants on the ecology of surface waters is also dependent on the characteristics of the receiving waters, particularly its water quality, hardness, flow rate and flow velocity.

A.1.2 The quantification of these impacts is represented by a prescriptive numerical assessment methodology for routine runoff. This methodology is described in DMRB LA 113. The assessment applies to concentrations of dissolved copper and zinc which are well known constituents of road runoff, both of which are relatively eco-toxic and for which there are well defined Environmental Quality Standards (EQS). These two pollutants are assessed as a proxy for other pollutants which may be present in road runoff.

A.2 HEWRAT

A.2.1 The assessment method used for determining whether routine runoff is likely to have an ecological impact on receiving surface watercourses is based on the HEWRAT tool developed by the Highways Agency (now National Highways). The tool provides an assessment of the short-term risks related to the intermittent nature of road runoff and also allows for an assessment of longer-term risks (over the period of one year) required to complete the risk assessment process. The assessment methodology provides results which are taken as an indicator as to whether there is sufficient dispersion and dilution available within the receiving water body to limit the impacts of highway drainage to acceptable levels.

A.2.2 HEWRAT uses a three-step approach to assessing the impacts of both soluble and sediment-bound pollutants and determines whether the drainage system would ‘pass’ or ‘fail’ in terms of water quality in the receiving water features during operation. The three-step approach is as follows:

- Step 1, the runoff quality (prior to any pre-treatment and discharge into a water body);
- Step 2, in river impacts (after dilution and dispersion);
- Step 3, in river impacts post-mitigation.

A.2.3 At Step 1, HEWRAT predicts the statistical distribution of key pollutant concentrations in untreated and undiluted highway runoff (the 'worst case' scenario) over a long release period. The results are assessed on a pass/fail basis against the toxicity thresholds. These represent a guideline emission standard in the absence of any pre-treatment within the drainage system or in-river dilution and dispersion. Most road drainage discharges 'fail' this step.

A.2.4 At Step 2 the assessment becomes more realistic and is only applied if one or both the toxicity thresholds are predicted to fail at Step 1. HEWRAT uses details of the highway catchment draining to the outfall, the flow rate of the receiving watercourse and its physical dimensions to calculate the available dilution of soluble pollutants and potential dispersion of sediments. For the soluble pollutants that cause acute impact, this involves a simple mass balance approach. For the sediment-bound pollutants that cause chronic impact, the ability of the receiving watercourse to disperse sediments is considered and, if sediment is expected to accumulate, the potential extent of sediment coverage is also considered. A Deposition Index (DI) is calculated for this purpose. The DI is then compared with a DI threshold. The current DI threshold is set at 100, with a value less than this passing the assessment.

A.2.5 Additionally, Step 2 contains two tiers of assessment for sediment accumulation: Tier 1 requires only an estimate of the river width. If an assessment fails at Tier 1 then a Tier 2 assessment can be undertaken which requires specific physical dimensions of the watercourse (such as cross section and downstream gradient). If a Tier 1 assessment indicates no risk, then a Tier 2 assessment is not required. Step 3 is described further in Mitigation – Step 3 below.

A.3 Soluble pollution

A.3.1 HEWRAT uses Runoff Specific Thresholds (RSTs) developed for significant soluble pollutants that have been identified in highway runoff. The RSTs are intended to protect organisms in receiving waters from short-term exposure (six hours and 24 hours) to these pollutants. The approach used to generate the RSTs is consistent with that adopted for the derivation of EQSs under the Water Framework Directive[1] (WFD). The RSTs have been agreed with the Environment Agency and incorporated within the HEWRAT assessment tools and guidance. The RST 24 hour is designed to protect against worst case conditions whereas the RST 6 hour is designed to protect against more typical exposure conditions of aquatic organisms.

[1] The Environment Agency, as the competent authority in England and Wales, is responsible for delivering the WFD through the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017. As retained law, the Directive continues to apply in the UK following Brexit on the 31st December 2020.

A.3.2 Dissolved copper (Cu) and dissolved zinc (Zn) are used as indicators of the level of impact as they can result in particularly acute toxic effects to aquatic life at certain concentrations. Table A.1 summarises the RSTs for dissolved Cu and dissolved Zn used within HEWRAT.

Table A.1 RSTs for short-term exposure (WRc, 2007) (taken from HEWRAT Help Guide, 2015)

		Zn (µg/l) Hardness		
Threshold	**Cu (µg/l)**	**Low (<50mg CaCO3/l)**	**Medium (50 – 200mg CaCO3/l)**	**High (>200mg CaCO3/l)**
RST 24 hour	21	60	92	385
RST 6 hour	42	120	184	770

A.3.3 A HEWRAT ‘pass’ or ‘fail’ for RSTs is determined through a calculation of the number of exceedances per year; Table A.2 shows the number of exceedances used to determine a HEWRAT ‘pass’.

Table A.2 Number of exceedances per year required to achieve a HEWRAT ‘pass’ (taken from HEWRAT Help Guide, 2015)

Metal	**Not within 1km of protected site.**		**Within 1km of protected site.**	
	RST 24	**RST 6**	**RST 24**	**RST 6**
Dissolved Cu	<2	<1	<1	<0.5
Dissolved Zn	<2	<1	<1	<0.5

A.3.4 An assessment of the long-term risks (using annual average concentrations) is also required to complete the risk assessment process. HEWRAT estimates in-river annual average concentrations for soluble pollutants (dissolved copper and dissolved zinc) which include the contribution from road runoff. These concentrations can be compared with published EQSs as shown in Table A.3, to assess whether there is likely to be a long-term impact on ecology.

Table A.3 EQS for Cu and Zn required to achieve ‘Good’ status under WFD

Metal	**Annual mean bioavailable concentration (µg/l)**
Copper (Cu)	1
Zinc (Zn)	10.9

A.3.5 HEWRAT calculates concentrations for total dissolved Cu and Zn, and in the absence of long-term water quality data, a comparison is made for exceedance against EQS for bioavailable Cu and Zn. This results in a conservative ‘worst-case’ assessment assuming that all dissolved Cu and Zn is bioavailable and therefore has the potential to have long-term negative environmental impacts on aquatic flora and fauna.

Sediment-bound Pollution

A.3.6 HEWRAT also assesses chronic impacts on aquatic ecology within watercourses associated with sediment-bound pollutants. Two standards are used for metal and polycyclic aromatic hydrocarbon (PAH) in sediment respectively, these are:

A.3.7 Threshold Effect Level (TEL) – concentration below which toxic effects are extremely rare; and

A.3.8 Probable Effect Level (PEL) – concentration above which toxic effects are observed on most occasions.

A.3.9 An alert is given for outfalls that would otherwise pass the assessment for sediment-bound pollutants, were it not for the following features being present downstream:

- a protected site within 1km of the point of discharge; and
- a structure, lake or pond within 100m of the point of discharge.

A.3.10 In both cases, the alert indicates the need for further consideration of the proposed outfall.

Mitigation – Step 3

A.3.11 Step 3 allows mitigation measures to be included in the assessment. Treatment efficiencies for a range of solutions are presented in Table 8.6.4N3 ‘Pollution and flow control measures options’ of DMRB, CG 501 Design of Highways Drainage systems (Highways England et al., 2020c). The treatment efficiencies within this table for pollution control have been reproduced below in Table A.4 ‘X’ is recorded where the removal of pollutants is likely to occur by the measure but insufficient evidence available to quote indicative treatment efficiencies.

Table A.4 Treatment efficiencies (taken from DMRB CG501 Design of Highways Drainage systems, 2020).

Name of measure	Suspended solids (% removal)	Dissolved Copper (% removal)	Dissolved Zinc (% removal)
Baffles	0	0	0
Combined kerb and drainage blocks	0	0	0
Combined kerb and gully	X	X	X
Combined surface and sub-surface drains/filter drain	60	0	45

Name of measure	Suspended solids (% removal)	Dissolved Copper (% removal)	Dissolved Zinc (% removal)
Ditch (vegetated)	25	15	15
Dry/Detention Basin	5	0	0
Infiltration Basin / Soakaway	Infiltration of water facilitates the removal of dissolved metals and solids.		
Notched weir	0	0	0
Penstock/Valve	0	0	0
Piped systems	0	0	0
Ponds	60	40	30
Reservoir pavement/pervious asphalt	50	0	0
Sedimentation tank	40	0	0
Sediment trap (catchpit)	X	X	X
Surface water channel	X	X	X
Swale/Grassed channel	80	50	50
Vortex chamber	0	0	0
Vortex grit separator	40	0	15
Wetland (surface flow)	60	30	50

A.3.12 To reduce the impacts from soluble pollutants there are two broad options for mitigation; either reduce the impact of the pollutant load via dilution or increase the level of treatment of the routine runoff prior to discharge to a receiving watercourse. Reducing the pollutant load via dilution can be achieved by limiting the discharge rate and thereby increasing the available dilution in the receiving water course (i.e. the discharge is released over a longer time period so the receiving watercourse can provide adequate dilution). When considering mitigation options, it should be noted that flow attenuation will not reduce annual average concentrations, against which EQS compliance is measured, as all the runoff will eventually reach the watercourse within any given year. For the purposes of identifying mitigation all Step 3 assessments have not considered potential discharge rates for attenuation ponds. Increasing dilution can also be achieved by discharging to a watercourse with a higher flow, however this can be restricted by land and highway levels and is not often feasible.

Mitigation – treatment train calculations

A.3.13 Through recent correspondence (February 2021) directly with National Highways, they advocated that the efficiency of each treatment component, within a SuDS treatment train, should be simply multiplied together to determine the combined efficiency.

A.3.14 This should be achieved by converting each individual % treatment efficiency into a factor (or decimal) and subtracting it from one (1 representing total pollutant load), representing percentage of pollutant remaining after treatment. These factors should then be multiplied together to represent a decimal of pollutants remaining after treatment. Finally, this calculated decimal should be subtracted from one (1 representing total pollutant load) before converting the value into an overall % treatment efficiency. A short-worked example is detailed below:

A.3.15 For example, CG501 suggests a Filter Drain will remove 60% of Total Suspended Solids (TSS) and a Detention Basin (dry pond) will remove 50% (see Table A.4). Where a SuDS treatment train consists of a Filter Drain followed by a Detention Basin, the combined efficiency is calculated as follows:

- The percentage treatment efficiencies, for TSS, for a Filter Drain and a Detention basin are 60% and 50% respectively. Firstly, both are converted into decimals; 60% becomes 0.6, 50% become 0.5. This decimal is subtracted from one, i.e. 1 – 0.6 = 0.4 (representing decimal of pollutant remaining) and 1 – 0.5 = 0.5 (representing decimal of pollutant remaining)
- 0.4 [Filter Drain factor] × 0.5 [Detention Basin factor] = 0.2 [combined factor]
- 1 – 0.2 [combined factor] = 0.8 (represents decimal of pollutants treated), then converting 0.8 back to a percentage, i.e. 80%
- For a SuDS treatment train involving Filter Drains and a Detention Basin, the overall treatment efficiency, for TSS, is 80% which is to be used within HEWRAT at Step 3.
- If a third treatment component were to be added, for example a vegetated ditch (25% suspended solids removal = 0.75), the calculation would be:
- 0.4 [Filter Drain factor] × 0.5 [Detention Basin factor] × 0.75 [Vegetated Ditch factor] = 0.15 [combined factor]
- Subtracting 0.15 from 1 gives a value of 0.85 and converting this back to a percentage gives an overall treatment efficiency for TSS for use in HEWRAT of 85%

Calculating catchment weighted treatment efficiencies

A.3.16 The following methodology has been used to calculate a weighted averaged treatment efficiency, used in HEWRAT assessments, when treatment trains vary between two catchments (or within the same catchment) that ultimately are being discharged into the same watercourse and need a cumulative assessment performed.

A.3.17 The three main steps of the methodology are as follows:

- Calculate out percentage of each catchment of the Total Area (of all catchments in the cumulative assessment), e.g., X% = X / (X+Y)
- Multiple catchment percentage (X%) to relevant Total treatment train efficiency
- Add both values from step 2 together to get final weighted treatment efficiency. Totals should be rounded down to the nearest number so as not to over-estimate the final treatment efficiency.

Assessment location and cumulative assessment methodology

A.3.18 Assessment locations have been chosen that are within an identified natural downstream receiving watercourse. If a discharge is into a ditch or drain (owned by National Highways) that discharges into a natural watercourse after a short distance, then for the purpose of assessment the natural watercourse has been used as the assessment location in accordance with DMRB LA 113.

A.3.19 When assessing potential impacts each outfall should be individually assessed in the first instance. Where more than one outfall discharges into the same reach of a watercourse the combined effects will be more significant. In these circumstances the outfalls should be aggregated for purposes of cumulative assessment within HEWRAT (subject to the proximity of the outfalls). To aggregate the outfalls the drained areas are simply added together.

A.3.20 The point for cumulative assessment should be downstream of the last outfall in the reach. For this purpose, a reach is defined as a length of watercourse between two confluences. The reason for this is that the available dilution and stream velocity will naturally change at confluences and influence the assessment. Reaches can vary greatly in length and, for assessment of impacts associated with soluble pollutants, where the reach is longer than 1km (measured along the watercourse) only outfalls within 1km should be aggregated for assessment. When assessing the potential impacts associated with sediment-bound pollutants, where the reach is longer than 100m only outfalls lying within 100m should be aggregated for assessment. Beyond 100m the sediment, if it settles at all, is likely to be sufficiently diluted with natural sediment.

Spillage risk

A.3.21 On all roads, there is a risk that an accidental spillage or vehicle fire may lead to an acute pollution incident. It is generally accepted that the risk on any road is proportionate to the risk of a Heavy Goods Vehicle (HGV) road traffic collision. As new or improved roads are designed to reduce the collision rate, they will also lead to fewer acute pollution impacts. Where spillages do reach a surface watercourse the pollution impact can be severe, but is usually of short duration, typical of an acute pollution impact. Spillage risk is assessed using the methodology in DMRB LA 113.

Annex B Assessment data for surface water

B.1.1 Outfall locations are presented on Figure 14.1.2 in Annex G. The data used in the HEWRAT assessments along with data sources, assumptions and uncertainties are presented in this Annex.

Baseline Data for HEWRAT routine runoff – Step 1

HEWRAT outfall assessment locations

B.1.2 Since the publication of the PEIR, some outfall locations within the drainage design have been added. Easting and Northing coordinates of all assessment locations are also presented in Table B.1.

Table B.1 HEWRAT outfall assessment locations

Design section and Outfall Number	Easting coordinate	Northing coordinate	Receiving Watercourse
S1 - OU01	574121.699	207957.944	River Chelmer
S1 - OU07	574038.04	209140.70	Ordinary Watercourse 2
S1 - OU07A	574232.98	209031.61	Ordinary Watercourse 2
S1 - OU10	574489.02	209504.87	Boreham Brook
S1 - OU10A	574516.14	209539.13	Boreham Brook
S1 - OU11	574623.54	209628.41	Boreham Brook
S1 - OU12	574671.60	209677.30	Boreham Brook
S1 - OU13	578450.74	211221.07	River Ter
S1 - OU14	578124.52	211563.03	Ordinary Watercourse 28
S1 - OU13A	578172.25	211423.00	Ordinary Watercourse 28
S1 - OU15	578332.85	211488.41	River Ter
S1 - OU17	578349.000	211513.000	River Ter (assessed on field drain at PEIR stage)
S1 - OU18	578336.236	211732.291	Ordinary Watercourse 31
S1 - OU19	579959.52	212020.57	Ordinary Watercourse 7

Design section and Outfall Number	Easting coordinate	Northing coordinate	Receiving Watercourse
S1 - OU19C	579788.40	212281.65	Ordinary Watercourse 7
S1 - OU19C1	579802.54	212251.24	Ordinary Watercourse 7
S1 - OU23 (+ 23C, 23D, 24A)	582393.309	212864.770	Ordinary Watercourse 32
S1 - OU23C	580355.04	212549.40	Ordinary Watercourse 32
S1 - OU23D	580490.15	212671.02	Ordinary Watercourse 32
S1 - OU24A	580668.19	212723.79	Ordinary Watercourse 32
S1 - OU24B	580819.150	212534.500	Ordinary Watercourse 32
S2 - OU03	582456.731	213399.198	Ordinary Watercourse 9
S2 - OU04	582894.964	213706.736	River Brain
S2 - OU05	582889.831	213724.495	River Brain
S2 - OU08	583006.174	214483.091	Ordinary Watercourse 9a
S2 - OU09	583146.326	215101.744	Ordinary Watercourse 10
S2 - OU09A	583025.00	215134.00	Ordinary Watercourse 10
S2 - OU10	583156.767	215096.713	Ordinary Watercourse 10
S2 - OU11	583138.463	215759.474	Ordinary Watercourse 11
S2 - OU14	583627.94	216087.11	Ordinary Watercourse 12a
S2 - OU15A	583537.74	216074.39	Ordinary Watercourse 12a
S2 - OU15C	583890.87	216117.71	Ordinary Watercourse 13
S2 - OU15C1	584344.85	216502.26	Ordinary Watercourse 15a
S2 - OU15D	583983.859	216225.374	Ordinary Watercourse 13
S2 - OU15D1	584400.74	215813.39	River Blackwater

Design section and Outfall Number	Easting coordinate	Northing coordinate	Receiving Watercourse
S2 - OU15E	583812.56	216191.65	Ordinary Watercourse 12a
S2 - OU15G	584321.68	216626.63	Rivenhall Brook
S2 - OU15H	584671.13	217318.85	Ordinary Watercourse 17
S2 - OU17	585419.04	217789.71	Existing Drainage (to River Blackwater)
S2 - OU18	585581.00	217720.10	River Blackwater
S2 - OU19	585410.558	217426.824	River Blackwater
S2 - OU24	584196.43	216832.89	Rivenhall Brook
S2 - OU24A	584201.72	216822.57	Rivenhall Brook
S2 - OU26	584567.85	217044.99	Ordinary Watercourse 17
S2 - OU27	585178.69	217481.52	River Blackwater
S3 - OU01	585969.00	217946.00	River Blackwater
S3 - OU02	586268.19	217971.21	Ordinary Watercourse 21
S3 - OU03	585726.87	217609.53	Ordinary Watercourse 18
S3 - OU04	586315.10	217675.36	Ordinary Watercourse 21
S3 - OU05	586055.94	218020.84	River Blackwater
S3 - OU06	587146.05	218409.94	Ordinary Watercourse 21a
S3 - OU07A	587071.69	218472.05	Ordinary Watercourse 21a
S3 - OU08	587443.15	218918.77	Domsey Brook d/s
S3 - OU08A	586975.60	218876.83	Domsey Brook d/s
S3 - OU08B&8D	587720.00	218698.00	Unnamed Ditch
S3 - OU08C	587869	218652	Existing Drainage (Inworth Rd)
S3 - OU08E	587816.37	218738.60	Existing Drainage (Inworth Rd)
S3 - OU09	587754.35	219057.51	Domsey Brook d/s
S3 - OU10	587921.32	219163.94	Domsey Brook d/s

Design section and Outfall Number	Easting coordinate	Northing coordinate	Receiving Watercourse
S3 - OU13	586697.86	218301.82	Ordinary Watercourse 35
S3 - OU14	586972.76	218215.47	Ordinary Watercourse 21a
S3 - OU15	591218.30	223333.90	Ordinary Watercourse 26
S3 - OU15B	591248.66	223254.27	Ordinary Watercourse 26
S3 - OU15C	591250.02	223254.27	Ordinary Watercourse 26
S3 - OU16 & OU15A	591387.87	223689.43	Ordinary Watercourse 36
S3 - OU17	592561.18	224215.99	Roman River
S3 - OU18	592796.00	224323.57	Roman River
S3 - OU19	587643.256	219089.543	Domsey Brook d/s
S3 - OU20	587859.50	219573.34	Unnamed Ditch
S3 - OU21	588138.71	219907.50	Ordinary Watercourse 23
S3 - OU22	588201.63	219865.47	Ordinary Watercourse 23
S3 - OU23	587854.46	219922.14	Ordinary Watercourse 23
S3 - OU24	587856.23	219924.11	Ordinary Watercourse 23
S3 - OU26	588281.129	220490.669	Ordinary Watercourse 37
S3 - OU26A	588506.76	220557.04	Ordinary Watercourse 37
S3 - OU26B	589775.06	221587.69	Ordinary Watercourse 38
S3 - OU27	589468.179	221193.152	Ordinary Watercourse 39
S3 - OU27A	588999.92	221003.55	Ordinary Watercourse 40
S3 - OU28	589689.760	221186.555	Ordinary Watercourse 39
S3 - OU29	589366.51	221466.69	Unnamed Ditch
S3 - OU30	589783.76	221720.45	Domsey Brook u/s

Design section and Outfall Number	Easting coordinate	Northing coordinate	Receiving Watercourse
S3 - OU30A	589716.17	221801.00	Domsey Brook u/s
S3 - OU31	590190.994	222054.547	Unnamed Ditch
S3 - OU32	590883.65	222206.77	Ordinary Watercourse 41
S3 - OU33	590217.540	222288.520	Ordinary Watercourse 42
IWR1	587941.280	218376.789	Existing Inworth Rd drainage but suspected to ultimately be Ordinary Watercourse 34
IWR2	587959.516	218357.305	Ordinary Watercourse 34
IWR3	588035.844	218153.152	Ordinary Watercourse 34
IWR4	588017.961	218018.198	Ordinary Watercourse 34
IWR5	588028.944	217820.383	Ordinary Watercourse 34C
IWR6	588059.358	217769.573	Ordinary Watercourse 34C
IWR7	588130.928	217706.794	Ordinary Watercourse 34C

Climatic Region

B.1.3 The study site is located in the southeast of England, within the Warm/dry climatic region based upon the figure in the HEWRAT v2.0 Help guide (Highways England, 2015).

Rainfall Site

B.1.4 Of the five rainfall sites in this region, Ipswich (SAAR 550mm) is located closest to the study area and therefore was considered the most representative and selected for all routine runoff assessments.

Traffic data sensitivity for routine runoff assessments

B.1.5 The assessments have been based upon modelled traffic data for the design year, 2042 in accordance with the DMRB LA 113 standard. Design years are typically dated 15 years after scheme opening, i.e. proposed scheme to be completed by 2027. HEWRAT banding for AADT is limited to a minimum of 10,000, where AADT is <10,000, or there is no data present for side roads (roads serving isolated properties have not been included in the traffic model), the minimum banding of >10,000 – <50,000 has been used. Where this scenario applies, the choice of banding follows the precautionary principle and the accompanying result, as stated in the HEWRAT v2.0 Help Guide (Highways England, 2015) should be viewed as conservative and likely to be an over estimation of the actual situation, thus providing a worst-case situation.

B.1.6 The available banding classifications for use in HEWRAT are as follows:

- >10,000 and <50,000
- >= 50,000 and <100,000
- >=100,000

B.1.7 In accordance with DMRB the two-way AADT has been calculated and used in the assessments where drainage catchments include both carriageways. Where only one carriageway is within a drainage catchment only the single (i.e. one-way) AADT value has been used for the relevant carriageway to determine the appropriate AADT banding (i.e. the other carriageway will drain to a different outfall). For all situations the highest AADT values of all roads within a drainage catchment have been used when selecting an AADT band to represent the maximum anticipated traffic volume within the drainage catchment.

B.1.8 Where predicted AADT values for any individual drainage catchment, predicted by the traffic model, were within 10% of the upper limit of the band the higher banding has been used in the assessments presented in this main report e.g., where AADT was predicted at 48,000, the >50,000 – 100,000 traffic banding was used and where the AADT predicted at 90,000, the >100,000 traffic banding was used. This adoption of a precautionary principal approach has applied to all the assessments undertaken. The results of this sensitivity analysis have informed mitigation requirements and assessment approaches. AADT bands used in the assessments are presented in Table B.2.

Table B.2 Highest AADT and AADT band for each outfall used in the HEWRAT assessments

Design section 1 (S1) of the proposed scheme, beyond A12 Junction 18 to beyond A12 Junction 21					
Outfall Number	Highest AADT	AADT band used	Outfall Number	Highest AADT	AADT band used
OU01	113045	>100k	OU17	123341	>100k
OU07	9756	10-50k	OU18	123341	>100k
OU07A	49342	50-100k	OU19	97015	>100k
OU10	8763	10-50k	OU19C	No traffic data (B road)	10-50k

Design section 1 (S1) of the proposed scheme, beyond A12 Junction 18 to beyond A12 Junction 21					
OU10A	3715	10-50k	OU19C1	No traffic data (B road)	10-50k
OU11	96041	>100k	OU23	110316	>100k
OU12	121731	>100k	OU23C	7909	10-50k
OU13	121731	>100k	OU23D	24839	10-50k
OU14	123341	>100k	OU24A	5395	10-50k
OU13A	11917	10-50k	OU24B	14865	10-50k
OU15	123341	>100k			

Section 2 (S2) of the proposed scheme, beyond A12 Junction 21 to beyond A12 Junction 23					
Outfall Number	Highest AADT	AADT band used	Outfall Number	Highest AADT	AADT band used
OU03	110316	>100k	OU15D	9586	10-50k
OU04	110316	>100k	OU15D1	9586	10-50k
OU05	110316	>100k	OU15E	19832	10-50k
OU08	110316	>100k	OU15G	106400	>100k
OU09	110316	>100k	OU15H	7338	10-50k
OU09A	110316	>100k	OU17	7338	10-50k
OU10	15971	10-50k	OU18	7338	10-50k
OU11	29739	10-50k	OU19	106400	>100k
OU14	24680	10-50k	OU24	7338	10-50k
OU15A	87968	50-100k	OU24A	7338	10-50k
OU15C	106400	>100k	OU26	2	10-50k
OU15C1	106400	>100k	OU27	2	10-50k

Section 3 (S3) of the proposed scheme, beyond A12 Junction 23 up to A12 Junction 25					
Outfall Number	Highest AADT	AADT band used	Outfall Number	Highest AADT	AADT band used
OU01	106400	>100k	OU17	126933	>100k
OU02	106400	>100k	OU18	126933	>100k
OU03	2595	10-50k	OU19	no data	10-50k
OU04	1495	10-50k	OU20	no data	10-50k
OU05	2899	10-50k	OU21	105451	>100k
OU06	5006	10-50k	OU22	no data	10-50k
OU07A	4615	10-50k	OU23	6943	10-50k
OU08	105451	>100k	OU24	7094	10-50k
OU08A	96791	>100k	OU26	105451	>100k
OU08B & 8D	22488	10-50k	OU26A	105451	>100k
OU08C	1599	10-50k	OU26B	105451	>100k
OU08E	1599	10-50k	OU27	no data	10-50k
OU09	105451	>100k	OU27A	no data	10-50k
OU10	105451	>100k	OU28	no data	10-50k
OU13	No data	10-50k	OU29	7899	10-50k
OU14	No data	10-50k	OU30	105451	>100k
OU15	14924	10-50k	OU30A	105451	>100k
OU15A & 16	94817	>100k	OU31	no data	10-50k
OU15B	No data	10-50k	OU32	no data	10-50k
OU15C	No data	10-50k	OU33	7898	10-50k

Inworth Road section (IWR) of the proposed scheme, adjacent to J24					
Outfall Number	Highest AADT	AADT band used	Outfall Number	Highest AADT	AADT band used
IWR1	~16000	10-50k	IWR5	~16000	10-50k
IWR2	~16000	10-50k	IWR6	~16000	10-50k
IWR3	~16000	10-50k	IWR7	~16000	10-50k
IWR4	~16000	10-50k			

B.2 Data for HEWRAT - Step 2 (in - river impacts)

Annual 95%ile river flow (Q_{95})

B.2.1 Q_{95} is the flow that is exceeded 95% of the time and is an indication of low flow. This figure is used within the calculations within HEWRAT as it provides a worst-case scenario for the flow of the receiving water at the time of discharge which influences its dilution capacity.

B.2.2 Many of the identified watercourses which will receive discharges of routine runoff from the proposed scheme have very low Q_{95}, flow estimates. Within HEWRAT the minimum Q_{95} value for any watercourse is set at 0.0011 m^3/s (at four decimal places), below which value (i.e. one litre per second) HEWRAT highlights to the user given the low flow value entered that the site could be considered a soakaway (i.e. can become dry and thus have no aquatic ecosystem at risk) and undertaking a groundwater risk assessment could be more appropriate (dependent upon underlying geology).

B.2.3 Initially, in the absence of proposed outfall locations, Q_{95} values were calculated for each location where the proposed scheme crossed a watercourse (i.e. approximately 28 locations) as showing in Figure 14.1.1 in Annex G. Q_{95} values were obtained from the WHS LowFlows Enterprise model and provided by Wallingford Hydro Solutions (WHS, 2021). The LowFlows Enterprise model relates flow statistics to climate and hydrological characteristics for the catchment of interest, and so can estimate low flow data for ungauged watercourses. For each assessment the Q_{95} location closest to the outfall was used providing that the outfall and the calculated Q_{95} location were at the same location. Where the outfall was upstream or downstream from the calculated Q_{95}, a proportional area calculation was used based on the catchment area at the two locations. When a Q_{95} value was not available that was considered to be representative of the watercourse or when a Q_{95} value calculated by Wallingford Hydro Solutions was less than the minimum value in HEWRAT the minimum value of 0.0011m^3/s was used.

B.2.4 Those outfalls for which a Q_{95} has been identified below the 0.0011m^3/s allowable in HEWRAT have been identified and depending upon the underlying geology have been assessed for impacts to groundwater. This is reported in Section 5 of this appendix and Annex C and H.

B.2.5 Q_{95} for each outfall, as originally calculated by Wallingford Hydro Solutions Ltd and the value used in the surface water assessments are presented in Table B.3.

Table B.3 Q_{95} for each assessment point

Design section 1 (S1) of the proposed scheme, beyond A12 Junction 18 to beyond A12 Junction 21							
Outfall Number	Receiving watercourse	Q_{95} calculated (m^3/s)	Q_{95} used in Assessment (m^3/s)	Outfall Number	Receiving watercourse	Q_{95} calculated (m^3/s)	Q_{95} used in Assessment (m^3/s)
OU01	River Chelmer	0.38[1]	0.38	OU17	River Ter	0.049[1]	0.049
OU07	Ordinary Watercourse 2	0.0003[1]	0.0011	OU18	Ordinary Watercourse 31	Not available	0.0011
OU07A	Ordinary Watercourse 2	0.0003[1]	0.0011	OU19	Ordinary Watercourse 7	0.00007[1]	0.0011
OU10	Boreham Brook	0.009[1]	0.009	OU19C	Ordinary Watercourse 7	0.00007[1]	0.0011
OU10A	Boreham Brook	0.009[1]	0.009	OU19C1	Ordinary Watercourse 7	0.00007[1]	0.0011
OU11	Boreham Brook	0.009[1]	0.009	OU23	Ordinary Watercourse 32	Not available	0.0011
OU12	Boreham Brook	0.009[1]	0.009	OU23C	Ordinary Watercourse 32	Not available	0.0011
OU13	River Ter	0.049[1]	0.049	OU23D	Ordinary Watercourse 32	Not available	0.0011
OU14	Ordinary Watercourse 28	Not available	0.0011	OU24A	Ordinary Watercourse 32	Not available	0.0011
OU13A	Ordinary Watercourse 28	Not available	0.0011	OU24B	Ordinary Watercourse 32	Not available	0.0011
OU15	River Ter	0.049[1]	0.049				

Design section 2 (S2) of the proposed scheme, beyond A12 Junction 21 to beyond A12 Junction 23							
Outfall Number	Receiving watercourse	Q_{95} calculated (m^3/s)	Q_{95} used in Assessment (m^3/s)	Outfall Number	Receiving watercourse	Q_{95} calculated (m^3/s)	Q_{95} used in Assessment (m^3/s)
OU03	Ordinary Watercourse 9	Not available	0.0011	OU15D	Unnamed Ditch	Not available	0.0011
OU04	River Brain	0.062[1]	0.062	OU15E	Ordinary Watercourse 13	Not available	0.0011
OU05	River Brain	0.062[1]	0.062	OU15G	Rivenhall Brook	0.006[1]	0.006
OU08	Ordinary Watercourse 9a	Not available	0.0011	OU15H	Ordinary Watercourse 17	0.001[1]	0.0011
OU09	Ordinary Watercourse 10	0.0003[1]	0.0011	OU17	Existing Drainage	Not available	0.0011
OU09A	Ordinary Watercourse 10	0.0003[1]	0.0011	OU18	River Blackwater	0.206[1]	0.206
OU10	Ordinary Watercourse 10	0.0003[1]	0.0011	OU19	River Blackwater	0.206[1]	0.206
OU11	Ordinary Watercourse 11	0.001[1]	0.0011	OU24	Rivenhall Brook	0.006[1]	0.006
OU14	Ordinary Watercourse 12	0.0001[1]	0.0011	OU24A	Rivenhall Brook	0.006[1]	0.006
OU15A	Ordinary Watercourse 12	0.0001[1]	0.0011	OU25	Unnamed Ditch	Not available	0.0011
OU15C	Ordinary Watercourse 13	Not available	0.0011	OU26	Ordinary Watercourse 17	0.001[1]	0.0011
OU15C1	Ordinary Watercourse 13	Not available	0.0011	OU27	River Blackwater	0.206[1]	0.206

Design section 3 (S3) of the proposed scheme, beyond A12 Junction 23 up to A12 Junction 26							
Outfall Number	Receiving Watercourse	Q_{95} calculated (m^3/s)	Q_{95} used in Assessment (m^3/s)	Outfall Number	Receiving watercourse	Q_{95} calculated (m^3/s)	Q_{95} used in Assessment (m^3/s)
OU01	River Blackwater	0.206[1]	0.206	OU17	Roman River	0.007[1]	0.007
OU02	Ordinary Watercourse 21	0.001	0.0011	OU18	Roman River	0.007[1]	0.007
OU03	Ordinary Watercourse 18	Not available	0.0011	OU19	Domsey Brook d/s	0.013[1]	0.013
OU04	Ordinary Watercourse 21	0.001[1]	0.0011	OU20	Domsey Brook d/s	0.0011	0.0011
OU05	River Blackwater	0.206[1]	0.206	OU21	Ordinary Watercourse 23	Not available	0.0011
OU06	Ordinary Watercourse 21a	Not available	0.0011	OU22	Ordinary Watercourse 23	Not available	0.0011
OU07A	Ordinary Watercourse 21a	Not available	0.0011	OU23	Ordinary Watercourse 23	Not available	0.0011
OU08	Domsey Brook d/s	0.013[1]	0.013	OU24	Ordinary Watercourse 23	Not available	0.0011
OU08A	Domsey Brook d/s	0.013[1]	0.013	OU26	Ordinary Watercourse 37	0.00063[1]	0.0011
OU08B&8D	Unnamed Ditch	Not available	0.0011	OU26A	Ordinary Watercourse 37	0.00063[1]	0.0011
OU08C	Existing Drainage (Inworth Rd, ultimately Domsey Brook d/s)	Not available	0.0011	OU26B	Ordinary Watercourse 38	Not available	0.002

Design section 3 (S3) of the proposed scheme, beyond A12 Junction 23 up to A12 Junction 26							
OU08E	Existing Drainage (Inworth Rd, ultimately Domsey Brook d/s)	Not available	0.0011	OU27	Ordinary Watercourse 39	Not available	0.0011
OU09	Domsey Brook d/s	0.013	0.013	OU27 A	Ordinary Watercourse 40	Not available	0.0011
OU10	Domsey Brook d/s	0.013	0.013	OU28	Ordinary Watercourse 39	Not available	0.0011
OU13	Ordinary Watercourse 35	Not available	0.0011	OU29	Unnamed Ditch	Not available	0.0011
OU14	Ordinary Watercourse 21a	Not available	0.0011	OU30	Domsey Brook u/s	0.002[1]	0.002
OU15	Ordinary Watercourse 26	Not available	0.0011	OU30 A	Domsey Brook u/s	0.002	0.002
OU15A & 16	Ordinary Watercourse 36	Not available	0.0011	OU31	Unnamed Ditch	Not available	0.0011
OU15B	Ordinary Watercourse 26	Not available	0.0011	OU32	Ordinary Watercourse 41	Not available	0.0011
OU15C	Ordinary Watercourse 26	Not available	0.0011	OU33	Ordinary Watercourse 42	Not available	0.0011

Inworth Road section (IWR) of the proposed scheme, adjacent to J24							
Outfall Number	Receiving Watercourse	Q_{95} calculated (m^3/s)	Q_{95} used in Assessment (m^3/s)	Outfall Number	Receiving watercourse	Q_{95} calculated (m^3/s)	Q_{95} used in Assessment (m^3/s)
IWR1	Existing Inworth Rd drainage but suspected	Not available	0.0011	IWR5	Ordinary Watercourse 34	Not available	0.0011

Inworth Road section (IWR) of the proposed scheme, adjacent to J24							
	to ultimately be Ordinary Watercourse 34						
IWR2	Ordinary Watercourse 34	Not available	0.0011	IWR6	Ordinary Watercourse 34	Not available	0.0011
IWR3	Ordinary Watercourse 34	Not available	0.0011	IWR7	Ordinary Watercourse 34	Not available	0.0011
IWR4	Ordinary Watercourse 34	Not available	0.0011				
[1] Signifies where the Q_{95} value is based off obtained values from the WHS LowFlows Enterprise model.							

B.3 Impermeable road area

B.3.1 The impermeable areas for the proposed scheme have been calculated by the drainage design team based upon the proposed drainage design. The impermeable areas in Table B.4 have been used in the HEWRAT assessments undertaken for the outfalls number documented. Although the impermeable areas for cumulative assessments undertaken have not been explicitly documented, they were simply calculated by summing the applicable areas of individual catchments together.

Table B.4 Proposed outfalls, receiving watercourses and impermeable areas

Design section 1 (S1) of the proposed scheme, beyond A12 Junction 18 to beyond A12 Junction 21					
Outfall Number	Receiving Watercourse	Impermeable Area (hectares)	Outfall Number	Receiving Watercourse	Impermeable Area (hectares)
OU01	River Chelmer	7.71	OU17	River Ter	4.45
OU07	Ordinary Watercourse 2	1.54	OU18	Ordinary Watercourse 31	2.12
OU07A	Ordinary Watercourse 2	0.84	OU19	Ordinary Watercourse 7	1.59

Design section 1 (S1) of the proposed scheme, beyond A12 Junction 18 to beyond A12 Junction 21					
OU10	Boreham Brook	0.66	OU19C	Ordinary Watercourse 7	0.58
OU10A	Boreham Brook	0.11	OU19C1	Ordinary Watercourse 7	0.56
OU11	Boreham Brook	1.62	OU23 (including 23C, 23D & 24A)	Ordinary Watercourse 32	11.193 = 8.443 (OU23) + 0.56 (23C) + 1.32 (OU23D) + 0.87 (OU24A)
OU12	Boreham Brook	2.54	OU23C	Ordinary Watercourse 32	0.56
OU13	River Ter	3.86	OU23D	Ordinary Watercourse 32	1.32
OU14	Ordinary Watercourse 28	0.48	OU24A	Ordinary Watercourse 32	0.87
OU13A	Ordinary Watercourse 28	0.21	OU24B	Ordinary Watercourse 32	1.17
OU15	River Ter	0.70			

Design section 2 (S2) of the proposed scheme, beyond A12 Junction 21 to beyond A12 Junction 23					
Outfall Number	Receiving Watercourse	Impermeable Area (hectares)	Outfall Number	Receiving Watercourse	Impermeable Area (hectares)
OU03	Ordinary Watercourse 9	0.46	OU15D	Ordinary Watercourse 13	0.31
OU04	River Brain	1.78	OU15D1	River Blackwater	0.04
OU05	River Brain	1.12	OU15E	Ordinary Watercourse 12a	0.62
OU08	Ordinary Watercourse 9a	3.44	OU15G	Rivenhall Brook	4.21

Design section 2 (S2) of the proposed scheme, beyond A12 Junction 21 to beyond A12 Junction 23					
Outfall Number	Receiving Watercourse	Impermeable Area (hectares)	Outfall Number	Receiving Watercourse	Impermeable Area (hectares)
OU09	Ordinary Watercourse 10	2.76	OU15H	Ordinary Watercourse 17	1.00
OU09A	Ordinary Watercourse 10	0.31	OU17	Existing Drainage	0.03
OU10	Ordinary Watercourse 10	1.03	OU18	River Blackwater	0.60
OU11	Ordinary Watercourse 11	0.99	OU19	River Blackwater	1.64
OU14	Ordinary Watercourse 12a	1.08	OU24	Rivenhall Brook	0.42
OU15A	Ordinary Watercourse 12a	3.83	OU24A	Rivenhall Brook	0.44
OU15C	Ordinary Watercourse 13	3.69	OU26	Ordinary Watercourse 17	0.78
OU15C1	Ordinary Watercourse 15a	0.48	OU27	River Blackwater	0.23

Design section 3 (S3) of the proposed scheme, beyond A12 Junction 23 up to A12 Junction 26					
Outfall Number	Receiving Watercourse	Impermeable Area (hectares)	Outfall Number	Receiving Watercourse	Impermeable Area (hectares)
OU01	River Blackwater	2.85	OU17	Roman River	7.44
OU02	Ordinary Watercourse 21	4.17	OU18	Roman River	1.79

Design section 3 (S3) of the proposed scheme, beyond A12 Junction 23 up to A12 Junction 26					
Outfall Number	Receiving Watercourse	Impermeable Area (hectares)	Outfall Number	Receiving Watercourse	Impermeable Area (hectares)
OU03	Ordinary Watercourse 18	0.41	OU19	Domsey Brook d/s	0.45
OU04	Ordinary Watercourse 21	0.26	OU20	Domsey Brook d/s	0.05
OU05	River Blackwater	0.30	OU21	Ordinary Watercourse 23	2.27
OU06	Ordinary Watercourse 21a	0.04	OU22	Ordinary Watercourse 23	0.45
OU07A	Ordinary Watercourse 21a	0.11	OU23	Ordinary Watercourse 23	0.56
OU08	Domsey Brook d/s	2.05	OU24	Ordinary Watercourse 23	1.20
OU08A	Domsey Brook d/s	2.70	OU26	Ordinary Watercourse 37	1.47
OU08B&8D	Unnamed Ditch	0.44	OU26A	Ordinary Watercourse 37	3.58
OU08C	Existing Drainage (Inworth Rd, ultimately Domsey Broo d/s)	0.08	OU26B	Ordinary Watercourse 38	0.49
OU08E	Existing Drainage (Inworth Rd, ultimately Domsey Brook d/s)	0.16	OU27	Ordinary Watercourse 39	0.28
OU09	Domsey Brook d/s	0.59	OU27A	Ordinary Watercourse 40	0.08

Design section 3 (S3) of the proposed scheme, beyond A12 Junction 23 up to A12 Junction 26					
Outfall Number	Receiving Watercourse	Impermeable Area (hectares)	Outfall Number	Receiving Watercourse	Impermeable Area (hectares)
OU10	Domsey Brook d/s	3.19	OU28	Ordinary Watercourse 39	0.18
OU13	Ordinary Watercourse 35	0.13	OU29	Unnamed Ditch	0.49
OU14	Ordinary Watercourse 21a	0.09	OU30	Domsey Brook u/s	3.86
OU15	Ordinary Watercourse 26	0.51	OU30A	Domsey Brook u/s	3.71
OU15A & 16	Ordinary Watercourse 36	2.30	OU31	Unnamed Ditch	0.39
OU15B	Ordinary Watercourse 26	0.17	OU32	Ordinary Watercourse 41	0.57
OU15C	Ordinary Watercourse 26	0.16	OU33	Ordinary Watercourse 42	3.50

Inworth Road section (IWR) of the proposed scheme, adjacent to J24					
Outfall Number	Receiving Watercourse	Impermeable Area (hectares)	Outfall Number	Receiving Watercourse	Impermeable Area (hectares)
IWR1	Existing Inworth Rd drainage but suspected to ultimately be Ordinary Watercourse 34	0.10	IWR5	Ordinary Watercourse 34C	0.17
IWR2	Ordinary Watercourse 34	0.39	IWR6	Ordinary Watercourse 34C	0.17

Inworth Road section (IWR) of the proposed scheme, adjacent to J24					
IWR3	Ordinary Watercourse 34	0.48	IWR7	Ordinary Watercourse 34C	0.11
IWR4	Ordinary Watercourse 34	0.48			

B.4 Permeable road area

B.4.1 In the absence of a comprehensive CCTV drainage survey for the assessments the permeable areas have not been calculated by the drainage team. It has therefore been assumed that the permeable area is zero. Some of the earthworks drainage have separate individual outfalls and do not combine with road runoff, while assuming zero permeable area for all catchments covers the worst-case scenario. Therefore, for all assessments the contributing permeable areas to road runoff value within HEWRAT has been set to zero.

Baseflow Index (BFI)

B.4.2 The BFIHOST value from the FEH webservice obtained for the Q_{95} calculations has been used in the assessments. This data is presented in Table B.5 however as BFI is a measure of the proportion of river runoff that derives from stored sources, the value assigned to it does not have an associated unit of measure. Where a BFI index value was not available at the exact outfall location, a value was used from the closest available point. As BFI index values do not differ greatly within catchments in most circumstances, depending upon underlying geology this was considered to be representative.

Table B.5 BFI for each assessment point

Design section 1 (S1) of the proposed scheme, beyond A12 Junction 18 to beyond A12 Junction 21					
Outfall Number	Receiving Watercourse	BFI (units n/a)	Outfall Number	Receiving Watercourse	BFI
OU01	River Chelmer	0.41	OU17	River Ter	0.46
OU07	Ordinary Watercourse 2	0.47	OU18	Ordinary Watercourse 31	0.46
OU07A	Ordinary Watercourse 2	0.47	OU19	Ordinary Watercourse 7	0.4

Design section 1 (S1) of the proposed scheme, beyond A12 Junction 18 to beyond A12 Junction 21					
OU10	Boreham Brook	0.53	OU19C	Ordinary Watercourse 7	0.4
OU10A	Boreham Brook	0.53	OU19C1	Ordinary Watercourse 7	0.4
OU11	Boreham Brook	0.53	OU23	Ordinary Watercourse 32	0.5
OU12	Boreham Brook	0.53	OU23C	Ordinary Watercourse 32	0.5
OU13	River Ter	0.46	OU23D	Ordinary Watercourse 32	0.5
OU14	Ordinary Watercourse 28	0.46	OU24A	Ordinary Watercourse 32	0.5
OU13	Ordinary Watercourse 28	0.46	OU24B	Ordinary Watercourse 32	0.5
OU15	River Ter	0.46			

Design section 2 (S2) of the proposed scheme, beyond A12 Junction 21 to beyond A12 Junction 23					
Outfall Number	Receiving Watercourse	BFI	Outfall Number	Receiving Watercourse	BFI
OU03	Ordinary Watercourse 9	0.53	OU15D	Ordinary Watercourse 13	0.51
OU04	River Brain	0.53	OU15D1	Unnamed Ditch	0.48
OU05	River Brain	0.53	OU15E	Ordinary Watercourse 13	0.51
OU08	Ordinary Watercourse 9a	0.55	OU15G	Rivenhall Brook	0.38
OU09	Ordinary Watercourse 10	0.55	OU15H	Ordinary Watercourse 17	0.48

Design section 2 (S2) of the proposed scheme, beyond A12 Junction 21 to beyond A12 Junction 23					
Outfall Number	Receiving Watercourse	BFI	Outfall Number	Receiving Watercourse	BFI
OU09A	Ordinary Watercourse 10	0.55	OU17	Existing Drainage	0.48
OU10	Ordinary Watercourse 10	0.55	OU18	River Blackwater	0.48
OU11	Ordinary Watercourse 11	0.48	OU19	River Blackwater	0.48
OU14	Ordinary Watercourse 12	0.51	OU24	Rivenhall Brook	0.38
OU15A	Ordinary Watercourse 12	0.51	OU24A	Rivenhall Brook	0.38
OU15C	Ordinary Watercourse 13	0.51	OU26	Ordinary Watercourse 17	0.48
OU15C1	Ordinary Watercourse 15a	0.38	OU27	River Blackwater	0.48

Design section 3 (S3) of the proposed scheme, beyond A12 Junction 23 up to A12 Junction 26					
Outfall Number	Receiving Watercourse	BFI	Outfall Number	Receiving Watercourse	BFI
OU01	River Blackwater	0.48	OU17	Roman River	0.47
OU02	Ordinary Watercourse 21	0.26	OU18	Roman River	0.47
OU03	Ordinary Watercourse 18	0.48	OU19	Domsey Brook d/s	0.36
OU04	Ordinary Watercourse 21	0.26	OU20	Domsey Brook d/s	0.36

Design section 3 (S3) of the proposed scheme, beyond A12 Junction 23 up to A12 Junction 26					
OU05	River Blackwater	0.48	OU21	Ordinary Watercourse 23	0.34
OU06	Ordinary Watercourse 21a	0.36	OU22	Ordinary Watercourse 23	0.34
OU07A	Ordinary Watercourse 21a	0.36	OU23	Ordinary Watercourse 23	0.34
OU08	Domsey Brook d/s	0.36	OU24	Ordinary Watercourse 23	0.34
OU08A	Domsey Brook d/s	0.36	OU26	Ordinary Watercourse 37	0.34
OU08B&8D	Unnamed Ditch	0.36	OU26A	Ordinary Watercourse 37	0.34
OU08C	Existing Drainage (Inworth Rd, ultimately Domsey Brook d/s)	0.36	OU26B	Ordinary Watercourse 38	0.38
OU08E	Existing Drainage (Inworth Rd, ultimately Domsey Brook d/s)	0.36	OU27	Ordinary Watercourse 39	0.38
OU09	Domsey Brook d/s	0.36	OU27A	Ordinary Watercourse 40	0.38
OU10	Domsey Brook d/s	0.36	OU28	Ordinary Watercourse 39	0.38
OU13	Ordinary Watercourse 35	0.26	OU29	Unnamed Ditch	0.38
OU14	Ordinary Watercourse 21a	0.36	OU30	Domsey Brook u/s	0.38

Design section 3 (S3) of the proposed scheme, beyond A12 Junction 23 up to A12 Junction 26					
OU15	Ordinary Watercourse 26	0.47	OU30A	Domsey Brook u/s	0.38
OU15A & 16	Ordinary Watercourse 36	0.47	OU31	Unnamed Ditch	0.38
OU15B	Ordinary Watercourse 26	0.47	OU32	Ordinary Watercourse 41	0.38
OU15C	Ordinary Watercourse 26	0.47	OU33	Ordinary Watercourse 42	0.38

Inworth Road section (IWR) of the proposed scheme, adjacent to J24					
Outfall Number	Receiving Watercourse	BFI	Outfall Number	Receiving Watercourse	BFI
IWR1	Existing Inworth Rd drainage but suspected to ultimately be Ordinary Watercourse 34	0.26	IWR5	Ordinary Watercourse 34C	0.26
IWR2	Ordinary Watercourse 34	0.26	IWR6	Ordinary Watercourse 34C	0.26
IWR3	Ordinary Watercourse 34	0.26	IWR7	Ordinary Watercourse 34C	0.26
IWR4	Ordinary Watercourse 34	0.26			

B.5 Protected sites

B.5.1 Designated protected sites (for nature conservation) are subject to more stringent criteria for HEWRAT assessments. A site designated as a SSSI would typically qualify to be noted as protected site within context of HEWRAT assessment. The Marks Tey SSSI is located within 1km of drainage outfalls in design section 3 of the proposed scheme. However, Marks Tey SSSI which is solely designated for geological purposes. As the purpose of the water quality assessments is to protect aquatic ecology the designation of Marks Tey SSSI has been disregarded and the non-SSSI criteria used when establishing magnitude of impact using the HEWRAT results.

B.5.2 Similarly, several outfalls within the proposed scheme as located within 1km of two local natures reserves (LNRs), Whetmead and Brockwell Meadows. LNRs are not considered designated sites which qualify for Protected Site status, in relation to HEWRAT routine runoff assessments. Therefore, the applicable outfalls within 1km of these sites are also not subject to the most stringent assessment criteria.

B.5.3 Although no protected sites have been identified for purposes of HEWRAT assessments undertaken, details of outfalls near Mark Tey SSI and Whetmead and Brockwell Meadows LNRs have been in noted in Table B.6. For additional context, some information about each site is documented after the Table B.6.

Table B.6 Outfalls within 1km downstream of a potential protected site

Outfall Number	Receiving Watercourse	Designated Site Name	Distance downstream from outfall (km)
Design section 2 (S2) of the proposed scheme, beyond A12 Junction 21 to beyond A12 Junction 23			
OU03	Unnamed Ditch	Whetmead LNR	0.55
OU04	River Brain	Whetmead LNR	0.00
OU05	River Brain	Whetmead LNR	0.00
OU08	Ordinary Watercourse 9a	Whetmead LNR	0.42
Design section 3 (S3) of the proposed scheme, beyond A12 Junction 23 up to A12 Junction 26			
OU06	Ordinary Watercourse 21a (tributary of Domsey Brook d/s)	Brockwell Meadows LNR	0.40
OU07A	Ordinary Watercourse 21a (tributary of Domsey Brook d/s)	Brockwell Meadows LNR	0.18
OU14	Ordinary Watercourse 21a (tributary of Domsey Brook d/s)	Brockwell Meadows LNR	0.70
OU08	Domsey Brook d/s	Brockwell Meadows LNR	0.70

Outfall Number	Receiving Watercourse	Designated Site Name	Distance downstream from outfall (km)
OU08A	Domsey Brook d/s	Brockwell Meadows LNR	0.46
OU15	Ordinary Watercourse 26 (tributary of Roman River)	Marks Tey Brickpit SSSI (geological site)	0.80
OU15A	Ordinary Watercourse 36 (tributary of Roman River)	Marks Tey Brickpit SSSI	0.50
OU15B	Ordinary Watercourse 26 (tributary of Roman River)	Marks Tey Brickpit SSSI	0.80
OU15C	Ordinary Watercourse 26 (tributary of Roman River)	Marks Tey Brickpit SSSI	0.80
OU16	Ordinary Watercourse 36 (tributary of Roman River)	Marks Tey Brickpit SSSI	0.30

B.5.4 Whetmead Local Nature Reserve is located south of the A12 at Witham, immediately adjacent to the River Brain left bank and River Blackwater right bank. It is a previous landfill site with unimproved grassland and lagoons, supporting a range of butterflies, dragon flies and seed-eating birds.

B.5.5 Brockwell Meadows Local Nature Reserve is located north of the A12, south of Kelvedon, immediately adjacent to the River Blackwater right bank and downstream of the Domsey Brook confluence. The site comprises of a water meadow, woodland, a pond and hedgerows.

B.5.6 The Marks Tey Brickpit SSSI is located north of the A12 at Marks Tey, with the site centred on NGR TL 911 242, covering an area of 29.82 hectares, is of geological interest and is noted as being in a favourable condition. Ordinary Watercourse 36 (Ordinary Watercourse 26 is a tributary of Ordinary Watercourse 36) flows through the site after which it discharges into the Roman River.

B.6 For Dissolved Zinc only

Water hardness

B.6.1 Three levels of water hardness can be selected within HEWRAT:

- Low = <50mg $CaCO_3$/l
- Medium = 50 – 200mg $CaCO_3$/l

- High = >200mg $CaCO_3$/l

B.6.2 Concentrations of water hardness is assumed to affect and influence dissolved zinc concentrations. For all routine runoff assessments undertaken, the 'High' level of water hardness was selected. This selection was based on data available via Environment Agency's Water Quality Archive, where locations within the study area (River Blackwater Appleford, River Boreham Hall Road and River Ter Crabbs Bridge) indicated (via an Alkalinity measurement), results consistently being recorded above 200mg $CaCO_3$/l (Environment Agency WIMS website, 2021). Although it is acknowledged measures of alkalinity (measure of the total amount of bases present typically sum of hydroxyl, carbonates and biocarbonates) and hardness (measure of total amount (concentration) of divalent salts) are different they often give results that are broadly similar. Predominately this is because calcium, magnesium, bicarbonate, and carbonate ions in fresh water are derived in equivalent quantities from the solution of limestone in geological deposits.

B.7 For Dissolved Copper only

B.7.1 For Ambient background concentration (ABC) data for copper was sourced from an Environment Agency WIMS archive station online, Feeringbury Old Mill on the River Blackwater. From the data available at this site, the average measured copper concentration is 2.36 µg/l (full details are provided in Annex D). A data request submitted to the Environment Agency confirmed the only available water quality data is the data on WIMS. For all initial HEWRAT assessments for the proposed design, the default ABC for copper used was 0 µg/l. For HEWRAT assessment that fail for EQS copper at Step 3 and required M-BAT assessment, the ABC for copper was set to 2.36 µg/l.

B.8 For sediment impact only

Step 2 Tier 1 data

Estimated river width at Q_{95} and presence of downstream structures

B.8.1 To assess the impacts relating to sediments river width at Q_{95} is required. DMRB does not provide a method by which this can be calculated. The default value of 5.0m in HEWRAT was not considered to be appropriate and so for each outfall location this width has been estimated from google aerial photos and organisational experience. The data is presented in Table B.7 below.

B.8.2 It is also necessary to identify whether any in-channel structures have the potential to reduce velocity and thus increase the likelihood of sediments accumulating. This was checked for each identified outfall using google aerial photos. This data is also presented in the Table B.7 below. It should be noted that the presence of a downstream structure does not change the outcome of the assessment but provides an 'Alert' for further consideration.

Table B.7 River width at Q_{95} and in-channel structures for Step 2 Tier 1 sediment impacts.

Design section 1(S1) of the proposed scheme, beyond A12 Junction 18 to beyond A12 Junction 21					
Outfall Number	River width at Q_{95} (estimated) (m)	Is there a structure, lake, pond or canal that reduces velocity within 100m of the point of discharge? (Yes/No)	Outfall Number	River width at Q_{95} (estimated) (m)	Is there a structure, lake, pond or canal that reduces velocity within 100m of the point of discharge? (Yes/No)
OU01	2	No	OU17	1	No
OU07	0.5	No	OU18	0.5	No
OU07A	0.5	No	OU19	0.5	No
OU10	0.5	No	OU19C	0.5	No
OU10A	0.5	No	OU19C1	0.5	No
OU11	0.5	No	OU23	0.5	No
OU12	0.5	No	OU23C	0.5	No
OU13	1	No	OU23D	0.5	No
OU14	0.5	No	OU24A	0.5	No
OU13A	0.5	No	OU24B	0.5	No
OU15	1	No			

Design section 2 (S2) of the proposed scheme, beyond A12 Junction 21 to beyond A12 Junction 23					
Outfall Number	River width at Q_{95} (estimated) (m)	Is there a structure, lake, pond or canal that reduces velocity within 100m of the point of discharge? (Yes/No)	Outfall Number	River width at Q_{95} (estimated) (m)	Is there a structure, lake, pond or canal that reduces velocity within 100m of the point of discharge? (Yes/No)
OU03	0.5	No	OU15D	0.5	No

Design section 2 (S2) of the proposed scheme, beyond A12 Junction 21 to beyond A12 Junction 23					
OU04	1	No	OU15D1	1.2	Yes
OU05	1	No	OU15E	0.5	Yes
OU08	0.5	No	OU15G	0.5	No
OU09	0.5	No	OU15H	0.5	Yes
OU09A	0.5	No	OU17	0.5	Yes
OU10	0.5	No	OU18	1.2	No
OU11	0.5	Yes	OU19	1.2	No
OU14	0.5	Yes	OU24	0.5	Yes
OU15A	0.5	Yes	OU24A	0.5	Yes
OU15C	0.5	Yes	OU26	0.5	No
OU15C1	0.5	No	OU27	1.2	No

Design section 3 (S3) of the proposed scheme, beyond A12 Junction 23 up to A12 Junction 26					
Outfall Number	River width at Q_{95} (estimated) (m)	Is there a structure, lake, pond or canal that reduces velocity within 100m of the point of discharge? (Yes/No)	Outfall Number	River width at Q_{95} (estimated) (m)	Is there a structure, lake, pond or canal that reduces velocity within 100m of the point of discharge? (Yes/No)
OU01	1.2	No	OU17	0.5	No
OU02	1.2	No	OU18	0.5	No
OU03	0.5	No	OU19	0.5	No
OU04	0.5	No	OU20	0.5	No
OU05	1.2	No	OU21	0.5	Yes
OU06	0.5	No	OU22	0.5	No
OU07A	0.5	No	OU23	0.5	Yes
OU08	0.5	No	OU24	0.5	Yes
OU08A	0.5	No	OU26	0.5	Yes

Design section 3 (S3) of the proposed scheme, beyond A12 Junction 23 up to A12 Junction 26					
OU08B	0.5	Yes	OU26A	0.5	No
OU08C	0.5	Yes	OU26B	0.5	No
OU08E	0.5	Yes	OU27	0.5	No
OU09	0.5	Yes	OU27A	0.5	No
OU10	0.5	No	OU28	0.5	Yes
OU13	0.5	Yes	OU29	0.5	No
OU14	0.5	No	OU30	0.5	No
OU15	0.5	Yes	OU30A	0.5	No
OU15A & 16	0.5	Yes	OU31	0.5	No
OU15B	0.5	Yes	OU32	0.5	No
OU15C	0.5	Yes	OU33	0.5	No

Inworth Road section (IWR) of the proposed scheme, adjacent to J24					
Outfall Number	River width at Q95 (estimated) (m)	Is there a structure, lake, pond or canal that reduces velocity within 100m of the point of discharge? (Yes/No)	Outfall Number	River width at Q95 (estimated) (m)	Is there a structure, lake, pond or canal that reduces velocity within 100m of the point of discharge? (Yes/No)
IWR1	0.5	No	IWR5	0.5	No
IWR2	0.5	No	IWR6	0.5	No
IWR3	0.5	No	IWR7	0.5	No
IWR4	0.5	No			

B.9 Step 2 Tier 2 data

B.9.1 Where the discharge fails the Step 2 Tier 1 assessment it is necessary to undertake a Tier 2 assessment. The data required for the Tier 2 assessments which relates to channel dimensions and gradients is presented in Table B.8 below for those outfalls where an assessment at Tier 2 was required. The data has been obtained from topographic data provide by the drainage team based on the proposed design for outfalls and organisational judgement where topographic data was not available.

Table B.8 Tier 2 parameters used for assessments

Outfall Number	Bed width (m)	Manning's n	Side Slope	Long Slope
Design section 1(S1) of the proposed scheme, beyond A12 Junction 18 to beyond A12 Junction 21				
OU19	0.6	0.07	1	0.0077
OU19C	2	0.07	0.5	0.0077
OU19C1	2	0.07	0.5	0.0077
Design section 2 (S2) of the proposed scheme, beyond A12 Junction 21 to beyond A12 Junction 23				
OU14	1	0.07	0.5	0.0017
OU15A	1	0.07	0.5	0.0017
OU15H	0.837	0.045	0.5	0.0067
OU15C	1	0.07	0.5	0.0017
OU15C1	0.5	0.07	1	0.0022
Design section 3 (S3) of the proposed scheme, beyond A12 Junction 23 up to A12 Junction 26				
OU15B	0.6	0.045	0.5	0.0032
OU30	1.35	0.045	1.2	0.0033
OU30A	1.35	0.045	1.2	0.0033

B.10 Accidental spillage risk assessment – input data

B.10.1 All outfalls that receive routine runoff have also been assessed for Accidental Spillage Risk to surface waters. Spillage risk is assessed for each outfall by breaking down each drainage catchment into sections of road with different risk weightings due to the type of road, as presented in Table B.9. The mainline and slip road sections of the A12 have been assessed with Motorway risk weighting values, as the design includes a hard strip and three lanes in sections of the mainline. This represents the worst-case scenarios as the traffic will have a closer risk to motorway risk than urban trunk road risk due to traffic volume (AADTs often >100,000) and speeds.

Table B.9 Risk weighting assigned to sections of road within drainage catchment for spillage risk assessment – (taken from DMRB LA 113 Appendix D)

Serious Spillages Rates (Billion of HGV km/year) AKA 'Risk Weighting'			
	Motorways	**Rural Trunk Roads**	**Urban Trunk Roads**
No Junction	0.36	0.29	0.31
Slip Road	0.43	0.83	0.36
Roundabout	3.09	3.09	5.35
Crossroad		0.88	1.46
Side Road		0.93	1.81
Total	0.37	0.45	0.85

B.10.2 This risk weighting is used in the assessment along with the length of road (per road type), the AADT and % of Heavy Goods Vehicles (HGV). The AADT and %HGV data for each road segment are extracted for the traffic model and road length measured from scheme design drawings. The probability score used for all outfalls is 0.45, as the scheme is within an urban environment. The predicted response time for emergency services to attend a spillage incident has been selected as <20 minutes based upon the proximity to Chelmsford and Colchester, as shown in Table B.10.

Table B.10 Probability of a serious pollution incident occurring as result of serious spillage score assigned based on response times (taken from DMRB LA 113 Appendix D)

Probability of a Serious Pollution Incident Occurring as Result of Serious Spillage			
Receiving water body	**Urban (response time to site <20 minutes)**	**Rural (response time to site <1 hour)**	**Remote (response time to site >1 hour)**
Surface watercourse	0.45	0.6	0.75
Groundwater	0.45	0.6	0.75

B.11 Additional baseline watercourse information

B.11.1 Table B.11 summaries the watercourses and catchments within the study area and details watercourses that will receive surface water runoff from the proposed scheme.

Table B.11 Summary of watercourse catchments and watercourses within the study area

<table>
<tr><th>Tributary</th><th>Tributary</th><th>Tributary</th><th>Tributary</th></tr>
<tr><td colspan="4">River Blackwater catchment</td></tr>
<tr><td colspan="4">River Blackwater (Receives outfall discharges from proposed outfalls S2-OU15D1, OU18, OU18 OU27, S3-OU01 and OU05.)</td></tr>
<tr><td rowspan="5">River Chelmer

(Receives outfall discharges from proposed outfall S1-OU01)</td><td colspan="3">Boreham Brook (Receives outfall discharges from proposed outfalls S1-OU10, OU10A, OU11 and OU12.)</td></tr>
<tr><td rowspan="2">River Ter

(Receives outfall discharges from proposed outfalls S1-OU13 and OU15.)</td><td colspan="2">Ordinary Watercourse 28 (Receives outfall discharges from proposed outfalls S1-OU13A and OU14.)</td></tr>
<tr><td>Ordinary Watercourse 31 (Receives outfall discharges from proposed outfalls S1-OU17 and OU18.)</td><td>Ordinary Watercourse 31b</td></tr>
<tr><td colspan="3">Ordinary Watercourse 1b, 2 and 3

(Ordinary Watercourse 2 receives outfall discharges from proposed outfall S1-OU07 and OU07A.)</td></tr>
<tr><td>Ordinary Watercourse 1</td><td colspan="2">Ordinary Watercourse 1a</td></tr>
<tr><td colspan="4">Ordinary Watercourse 7, 32, 9, 9a, 9d, 9e, 9f, 9g, 9h, 9j

(Ordinary Watercourse 7 receives outfall discharges from proposed outfalls S1-OU19, OU19C and OU19C1.)

(Ordinary Watercourse 32 receives outfall discharges from proposed outfalls S1-OU23, OU23C, OU23D, OU24A and OU24B.)

(Ordinary Watercourse 9a receives outfall discharges from proposed outfalls S2-OU08.)</td></tr>
<tr><td>Ordinary Watercourse 9b</td><td colspan="3">Ordinary Watercourse 9c</td></tr>
<tr><td colspan="4">Ordinary Watercourse 10 and 11

(Ordinary Watercourse 10 receives outfall discharges from proposed outfalls S2-OU09, OU09A and OU10.)

(Ordinary Watercourse 11 receives outfall discharges from proposed outfall S2- OU1.)</td></tr>
</table>

Tributary	Tributary	Tributary	Tributary
River Blackwater catchment			
Ordinary Watercourse 12	Ordinary Watercourse 12a (Receives outfall discharges from proposed outfalls S2-OU14, OU15A and OU15E.)		
Ordinary Watercourse 13 (Receives outfall discharges from proposed outfalls S2-OU15C and OU15D.)	Ordinary Watercourse 13a		
Ordinary Watercourse 15 (Receives outfall discharges from proposed outfall S2-OU15C1.)	Ordinary Watercourse 15a		
Ordinary Watercourse 17, 18, 33 and 35 (Ordinary Watercourse 17 receives outfall discharges from proposed outfalls S2-OU15H and OU26.) (Ordinary watercourse 18 receives outfall discharges from proposed outfall S3-OU03.) (Ordinary Watercourse 35 receives outfall discharges from proposed outfall S3-OU13.)			
Ordinary Watercourse 21 (Receives outfall discharges from proposed outfalls S3-OU02 and OU04.)	Ordinary Watercourse 21a (Receives outfall discharges from proposed outfalls S3-OU06, OU07A and OU14.)		
Domsey Brook (Receives outfall discharges from proposed outfalls S3-OU08,	Ordinary Watercourse 34 (Receives outfall discharges from proposed outfalls S3-OU-IW2.)	Ordinary Watercourse 34a, 34b, 34c (Ordinary Watercourse 34c receives outfall discharges from proposed outfalls S3-OU-IW3, OU-IW4, OU-IW5, OU-IW6, OU-IW7.)	
	Ordinary Watercourse 37	Ordinary Watercourse 23, 24 and 37h	

<table>
<tr><th>Tributary</th><th>Tributary</th><th>Tributary</th><th>Tributary</th></tr>
<tr><td colspan="4">River Blackwater catchment</td></tr>
<tr><td rowspan="4">OU08A, OU09, OU10, OU19, OU20, OU30 and OU30A.)</td><td>(Receives outfall discharges from proposed outfalls S3-OU26 and OU26A.)</td><td colspan="2">(Ordinary Watercourse 23 receives outfall discharges from proposed outfalls S3-OU21, OU22, OU23 and OU24.)</td></tr>
<tr><td colspan="3">Ordinary Watercourse 39, 41 and 42
(Ordinary Watercourse 39 receives outfall discharges from proposed outfalls S3-OU27, and OU28.)
(Ordinary Watercourse 40 receives outfall discharges from proposed outfall S3 – OU27A)
(Ordinary Watercourse 42 receives outfall discharges from proposed outfall S3-OU33.)
(Ordinary Watercourse 41 Receives outfall discharges from proposed outfall S3-OU32.)</td></tr>
<tr><td>Ordinary Watercourse 38
(Receives outfall discharges from proposed outfall S3-OU26B.)</td><td colspan="2">Ordinary Watercourse 38b</td></tr>
<tr><td>Ordinary Watercourse 26
(Receives outfall discharges from proposed outfalls S3-OU15, OU15B and OU15C.)</td><td colspan="2">Ordinary Watercourse 26a</td></tr>
<tr><td colspan="4">Rivenhall Brook (Receives outfall discharges from proposed outfalls S2-OU15G, OU24 and OU24A.)</td></tr>
<tr><td colspan="4">River Brain (Receives outfall discharges from proposed outfalls S2-OU04 and OU05.)</td></tr>
<tr><td>River Colne catchment</td><td></td><td></td><td></td></tr>
<tr><td>Roman River
(Receives outfall discharges from proposed outfalls S3-OU17 and OU18.)</td><td>Ordinary Watercourse 36
(Receives outfall discharges from proposed outfalls S3-OU15A and OU16.)</td><td colspan="2">Ordinary Watercourse 36a</td></tr>
</table>

Annex C Routine runoff results

C.1.1 The results of the HEWRAT Step 2 routine runoff assessments associated with all outfalls outlined for the proposed scheme, are shown in Table C.1 for single outfalls to non-low flow watercourses. For sediment-bound pollutants Step 2 Tier 2 assessments have been undertaken. Where failures occur at Tier 1, Tier 2 assessments have been undertaken for those watercourses which are not considered to be low flow watercourses.

C.1.2 Table C.2 presents the results of the cumulative assessments for at Step 2 for soluble pollutants associated with routine runoff for the non-low flow watercourses. Of the cumulative assessments undertaken 10 included a sediment assessment component, i.e. the outfalls involved are less than 100m apart and these are presented in the last column of Table C.2. These assessments have been run with ABC for copper set at 0.0µg/l.

C.1.3 Table C.3 presents the results for the single outfall HEWRAT assessments for those outfalls assessed as groundwater to low flow watercourses at Step 3 including embedded mitigation. Table C.4 presents the assessment results for the cumulative assessments for those outfalls assessed as groundwater to low flow watercourses at Step 3. For low flow watercourses, where Tier 1 sediment failures occur, Tier 2 assessments have not been undertaken as the significance of effect has been based upon the groundwater assessments which do not require a comparison to be made with sediment-bound pollutants, thus the Tier 1 results for these watercourses have been provided for information only.

C.1.4 Table C.5 presents the HEWRAT assessment results for the existing outfalls. It should be noted that these existing outfall results are not directly comparable with results from the proposed scheme due to changes in contributing catchment areas. Step 2 results have been presented as currently there is limited treatment for water quality on the existing road network within the scheme extent. If any treatment is provided its effectiveness has not been established and thus as a worst-case it has been assumed there is no treatment provided. Only those existing outfalls that discharge to non-low flow watercourses have been assessed.

C.1.5 Outfalls are associated with the Inworth Road (B1023) section of the proposed scheme (adjacent to J24 within S3). The upgraded proposed design for the road required routine runoff assessments. It should be noted that at the time of writing certain details associated with these seven drainage catchments are subject to change and outfall locations have not been confirmed through drainage surveys and have been assumed for the purposes of this assessment. An additional cumulative assessment (in addition to the 28 cumulative assessments undertaken for design sections 1, 2 and 3) for the seven catchments associated with Inworth Road were undertaken for Step 2 Tier 1 and Step 3. Results for all the Inworth Road assessments are included in the results tables for the proposed scheme.

C.1.6 Within these tables, a traffic light system has been used to aid interpretation: - green shading indicates a HEWRAT 'Pass', and red shading indicates a HEWRAT 'Fail'. Additionally, where '(Alert)' text is included alongside a 'Pass' result for sediment bound pollutants, this indicates the receiving watercourse is within 1km of a designated nature conservation site and/or to highlight that there is a downstream structure (i.e. lake, pond, canal) within 100m of the point of discharge. Further details on protected sites are presented in Annex B. Any 'Alert' result generated by HEWRAT for sediment bound pollutants indicates a Pass result for that parameter. All the input data used in the assessments is presented in Annex B and receiving watercourses are shown in Figure 14.1.2 in Annex G for Table C.1, and Figure 14.1.3 in Annex G in Table C.2.

C.1.7 It should be noted outfalls within 1km of designated protected site are subject to RST exceedance limits that are half the standard limits. No outfalls have been subject to these more stringent limits as discussed in Section 3 of this appendix).

C.1.8 For sediment bound pollutants, DI is reported in brackets if applicable and Tier 1 assessments were undertaken unless otherwise stated in the column in Table C.1 and Table C.2.

Table C.1 HEWRAT routine runoff single outfalls results (Step 2 pre-mitigation)

Outfall Number	Receiving Watercourse	Annual Average Concentration related to EQS Compliance (ABC for Copper = 0.0µg/l): EQS Copper = 1.0µg/l and Zinc = 10.9µg/l		Acute Soluble Copper & Zinc Number of exceedances per year (RST exceedance limits in brackets)				Sediment Bound Pollutants (Pass / Fail)	Settlement required for sediments (where failure reported).
		Copper (µg/l)	Zinc (µg/l)	Copper RST24 (2)	Copper RST6 (1)	Zinc RST24 (2)	Zinc RST6 (1)		
S1-OU01	River Chelmer	0.03	0.08	0.00	0.00	0.00	0.00	Pass	-
S1 - OU07	Ordinary Watercourse 2	0.53	1.19	1.40	0.20	0.00	0.00	Fail (216) (tier 1 only, assessed for GW impacts)	54%
S1 - OU07A	Ordinary Watercourse 2	0.41	0.95	0.80	0.20	0.00	0.00	Fail (118) (tier 1 only, assessed for GW impacts)	15%
S1 - OU10	Boreham Brook	0.04	0.09	0.00	0.00	0.00	0.00	Pass	-
S1 - OU10A	Boreham Brook	0.01	0.02	0.00	0.00	0.00	0.00	Pass	-
S1 - OU11	Boreham Brook	0.21	0.69	0.50	0.00	0.00	0.00	Pass	-
S1 - OU12	Boreham Brook	0.31	1.03	0.80	0.10	0.00	0.00	Pass	-

Outfall Number	Receiving Watercourse	Annual Average Concentration related to EQS Compliance (ABC for Copper = 0.0µg/l): EQS Copper = 1.0µg/l and Zinc = 10.9µg/l		Acute Soluble Copper & Zinc Number of exceedances per year (RST exceedance limits in brackets)				Sediment Bound Pollutants (Pass / Fail)	Settlement required for sediments (where failure reported).
		Copper (µg/l)	Zinc (µg/l)	Copper RST24 (2)	Copper RST6 (1)	Zinc RST24 (2)	Zinc RST6 (1)		
S1 - OU13	River Ter	0.10	0.32	0.00	0.00	0.00	0.00	Pass	-
S1 - OU14	Ordinary Watercourse 28	0.45	1.50	1.90	0.40	0.00	0.00	Pass	-
S1 - OU13A	Ordinary Watercourse 28	0.10	0.23	0.00	0.00	0.00	0.00	Pass	-
S1 - OU15	River Ter	0.02	0.06	0.00	0.00	0.00	0.00	Pass	-
S1 - OU17	River Ter	0.11	0.36	0.00	0.00	0.00	0.00	Pass	-
S1 - OU18	Ordinary Watercourse 31	1.39	4.62	10.30	2.40	0.5	0.00	Fail (297) (tier 1 only, assessed for GW impacts)	67%
S1 - OU19	Ordinary Watercourse 7	1.11	3.67	8.10	1.60	0.40	0.00	Pass (32) (Tier 2 Assessment)	-

Outfall Number	Receiving Watercourse	Annual Average Concentration related to EQS Compliance (ABC for Copper = 0.0µg/l): EQS Copper = 1.0µg/l and Zinc = 10.9µg/l		Acute Soluble Copper & Zinc Number of exceedances per year (RST exceedance limits in brackets)				Sediment Bound Pollutants (Pass / Fail)	Settlement required for sediments (where failure reported).
		Copper (µg/l)	Zinc (µg/l)	Copper RST24 (2)	Copper RST6 (1)	Zinc RST24 (2)	Zinc RST6 (1)		
S1 - OU19C	Ordinary Watercourse 7	0.25	0.54	0.50	0.00	0.00	0.00	Pass (23) (Tier 2 Assessment)	-
S1 - OU19C1	Ordinary Watercourse 7	0.24	0.53	0.50	0.00	0.00	0.00	Pass (23) (Tier 2 Assessment)	-
S1 - OU23 (+ 23C, 23D, 24A)	Ordinary Watercourse 32	3.32	11.08	31.90	12.60	1.90	0.40	Fail (1566) (tier 1 only, assessed for GW impacts)	94%
S1 - OU23C	Ordinary Watercourse 32	0.25	0.55	0.40	0.00	0.00	0.00	Pass	-
S1 - OU23D	Ordinary Watercourse 32	0.48	1.07	1.00	0.20	0.00	0.00	Fail (185) (tier 1 only, assessed for GW impacts)	46%
S1 - OU24A	Ordinary Watercourse 32	0.35	0.78	0.80	0.10	0.00	0.00	Fail (122) (tier 1 only, assessed for GW impacts)	18%

Outfall Number	Receiving Watercourse	Annual Average Concentration related to EQS Compliance (ABC for Copper = 0.0µg/l): EQS Copper = 1.0µg/l and Zinc = 10.9µg/l		Acute Soluble Copper & Zinc Number of exceedances per year (RST exceedance limits in brackets)				Sediment Bound Pollutants (Pass / Fail)	Settlement required for sediments (where failure reported).
		Copper (µg/l)	Zinc (µg/l)	Copper RST24 (2)	Copper RST6 (1)	Zinc RST24 (2)	Zinc RST6 (1)		
S1 - OU24B	Ordinary Watercourse 32	0.44	0.98	0.80	0.10	0.00	0.00	Fail (164) (tier 1 only, assessed for GW impacts)	39%
S2 - OU03	Ordinary Watercourse 9	0.44	1.45	1.70	0.30	0.00	0.00	Pass	-
S2 - OU04	River Brain	0.04	0.12	0.00	0.00	0.00	0.00	Pass	-
S2 - OU05	River Brain	0.02	0.08	0.00	0.00	0.00	0.00	Pass	-
S2 - OU08	Ordinary Watercourse 9a	1.92	6.39	16.90	4.70	0.60	0.1	Fail (513) (tier 1 only, assessed for GW impacts)	81%
S2 - OU09	Ordinary Watercourse 10	1.68	5.61	14.30	3.80	0.60	0.00	Fail (412) (tier 1 only, assessed for GW impacts)	76%

Outfall Number	Receiving Watercourse	Annual Average Concentration related to EQS Compliance (ABC for Copper = 0.0µg/l): EQS Copper = 1.0µg/l and Zinc = 10.9µg/l		Acute Soluble Copper & Zinc Number of exceedances per year (RST exceedance limits in brackets)				Sediment Bound Pollutants (Pass / Fail)	Settlement required for sediments (where failure reported).
		Copper (µg/l)	Zinc (µg/l)	Copper RST24 (2)	Copper RST6 (1)	Zinc RST24 (2)	Zinc RST6 (1)		
S2 - OU09A	Ordinary Watercourse 10	0.32	1.05	0.80	0.00	0.00	0.00	Pass	-
S2 - OU10	Ordinary Watercourse 10	0.41	0.91	0.90	0.10	0.00	0.00	Fail (154) (tier 1 only, assessed for GW impacts)	35%
S2 - OU11	Ordinary Watercourse 11	0.39	0.86	0.80	0.10	0.00	0.00	Fail (139) (Alert D/S structure) (tier 1 only, assessed for GW impacts)	28%
S2 - OU14	Ordinary Watercourse 12a	0.41	0.92	0.80	0.10	0.00	0.00	Fail (151) (tier 1 only, assessed for GW impacts)	34%
S2 - OU15A	Ordinary Watercourse 12a	1.15	2.67	7.10	1.10	0.00	0.00	Fail (536) (tier 1 only, assessed for GW impacts)	82%
S2 - OU15C	Ordinary Watercourse 13	1.95	6.49	17.20	4.60	0.70	0.00	Fail (516) (tier 1 only, assessed for GW impacts)	81%

Outfall Number	Receiving Watercourse	Annual Average Concentration related to EQS Compliance (ABC for Copper = 0.0µg/l): EQS Copper = 1.0µg/l and Zinc = 10.9µg/l		Acute Soluble Copper & Zinc Number of exceedances per year (RST exceedance limits in brackets)				Sediment Bound Pollutants (Pass / Fail)	Settlement required for sediments (where failure reported).
		Copper (µg/l)	Zinc (µg/l)	Copper RST24 (2)	Copper RST6 (1)	Zinc RST24 (2)	Zinc RST6 (1)		
S2 - OU15C1	Ordinary Watercourse 15a	0.44	1.45	2.00	0.30	0.00	0.00	Pass	-
S2 - OU15D	Ordinary Watercourse 13	0.15	0.33	0.00	0.00	0.00	0.00	Pass	-
S2 - OU15D1	River Blackwater	0.00	0.00	0.00	0.00	0.00	0.00	Pass (Alert D/S structure)	-
S2 - OU15E	Ordinary Watercourse 12a	0.27	0.59	0.50	0.00	0.00	0.00	Pass (Alert D/S structure)	-
S2 - OU15G	Rivenhall Brook	0.65	2.14	3.40	0.80	0.10	0.00	Pass	-
S2 - OU15H	Ordinary Watercourse 17	0.42	0.93	0.80	0.10	0.00	0.00	Pass at Tier 2. (Alert D/S structure)	-
S2 - OU17	Existing Drainage (to	0.00	0.00	0.00	0.00	0.00	0.00	Pass (Alert D/S structure)	-

Outfall Number	Receiving Watercourse	Annual Average Concentration related to EQS Compliance (ABC for Copper = 0.0µg/l): EQS Copper = 1.0µg/l and Zinc = 10.9µg/l		Acute Soluble Copper & Zinc Number of exceedances per year (RST exceedance limits in brackets)				Sediment Bound Pollutants (Pass / Fail)	Settlement required for sediments (where failure reported).
		Copper (µg/l)	Zinc (µg/l)	Copper RST24 (2)	Copper RST6 (1)	Zinc RST24 (2)	Zinc RST6 (1)		
	River Blackwater)								
S2 - OU18	River Blackwater	0.00	0.00	0.00	0.00	0.00	0.00	Pass	-
S2 - OU19	River Blackwater	0.01	0.03	0.00	0.00	0.00	0.00	Pass	-
S2 - OU24	Rivenhall Brook	0.04	0.09	0.00	0.00	0.00	0.00	Pass (Alert D/S structure)	-
S2 - OU24A	Rivenhall Brook	0.04	0.09	0.00	0.00	0.00	0.00	Pass (Alert D/S structure)	-
S2 - OU26	Ordinary Watercourse 17	0.32	0.71	0.70	0.00	0.00	0.00	Fail (109) (tier 1 only, assessed for GW impacts)	9%
S2 - OU27	River Blackwater	0.00	0.00	0.00	0.00	0.00	0.00	Pass	-
S3 - OU01	River Blackwater	0.02	0.06	0.00	0.00	0.00	0.00	Pass	-

Outfall Number	Receiving Watercourse	Annual Average Concentration related to EQS Compliance (ABC for Copper = 0.0µg/l): EQS Copper = 1.0µg/l and Zinc = 10.9µg/l		Acute Soluble Copper & Zinc Number of exceedances per year (RST exceedance limits in brackets)				Sediment Bound Pollutants (Pass / Fail)	Settlement required for sediments (where failure reported).
		Copper (µg/l)	Zinc (µg/l)	Copper RST24 (2)	Copper RST6 (1)	Zinc RST24 (2)	Zinc RST6 (1)		
S3 - OU02	Ordinary Watercourse 21	2.09	6.95	17.90	5.40	0.80	0.10	Fail (584) (tier 1 only, assessed for GW impacts)	83%
S3 - OU03	Ordinary Watercourse 18	0.19	0.42	0.20	0.00	0.00	0.00	Pass	-
S3 - OU04	Ordinary Watercourse 21	0.12	0.26	0.00	0.00	0.00	0.00	Pass	-
S3 - OU05	River Blackwater	0.00	0.00	0.00	0.00	0.00	0.00	Pass	-
S3 - OU06	Ordinary Watercourse 21a	0.02	0.05	0.00	0.00	0.00	0.00	Pass	-
S3 - OU07A	Ordinary Watercourse 21a	0.06	0.12	0.00	0.00	0.00	0.00	Pass (Alert D/S structure)	-
S3 - OU08	Domsey Brook d/s	0.18	0.59	0.30	0.00	0.00	0.00	Pass	-

Outfall Number	Receiving Watercourse	Annual Average Concentration related to EQS Compliance (ABC for Copper = 0.0µg/l): EQS Copper = 1.0µg/l and Zinc = 10.9µg/l		Acute Soluble Copper & Zinc Number of exceedances per year (RST exceedance limits in brackets)				Sediment Bound Pollutants (Pass / Fail)	Settlement required for sediments (where failure reported).
		Copper (µg/l)	Zinc (µg/l)	Copper RST24 (2)	Copper RST6 (1)	Zinc RST24 (2)	Zinc RST6 (1)		
S3 - OU08A	Domsey Brook d/s	0.23	0.76	0.50	0.00	0.00	0.00	Pass	-
S3 - OU08B& 8D	Unnamed Ditch	0.18	0.41	0.20	0.00	0.00	0.00	Pass (Alert D/S structure)	-
S3 - OU08C	Unnamed Ditch	0.04	0.08	0.00	0.00	0.00	0.00	Pass (Alert D/S structure)	-
S3 - OU08E	Unnamed Ditch	0.08	0.18	0.00	0.00	0.00	0.00	Pass (Alert D/S structure)	-
S3 - OU09	Domsey Brook d/s	0.06	0.18	0.00	0.00	0.00	0.00	Pass (Alert D/S structure)	-
S3 - OU10	Domsey Brook d/s	0.27	0.88	0.80	0.00	0.00	0.00	Pass	-
S3 - OU13	Ordinary Watercourse 35	0.06	0.14	0.00	0.00	0.00	0.00	Pass (Alert D/S structure)	-

Outfall Number	Receiving Watercourse	Annual Average Concentration related to EQS Compliance (ABC for Copper = 0.0µg/l): EQS Copper = 1.0µg/l and Zinc = 10.9µg/l		Acute Soluble Copper & Zinc Number of exceedances per year (RST exceedance limits in brackets)				Sediment Bound Pollutants (Pass / Fail)	Settlement required for sediments (where failure reported).
		Copper (µg/l)	Zinc (µg/l)	Copper RST24 (2)	Copper RST6 (1)	Zinc RST24 (2)	Zinc RST6 (1)		
S3 - OU14	Ordinary Watercourse 21a	0.05	0.10	0.00	0.00	0.00	0.00	Pass (Alert D/S structure)	-
S3 - OU15	Ordinary Watercourse 26	0.23	0.51	0.30	0.00	0.00	0.00	Pass (Alert D/S structure)	-
S3 - OU15B	Ordinary Watercourse 26	0.09	0.19	0.00	0.00	0.00	0.00	Pass (Alert D/S structure)	-
S3 - OU15C	Ordinary Watercourse 26	0.08	0.18	0.00	0.00	0.00	0.00	Pass (Alert D/S structure)	-
S3 - OU16 & OU15A	Ordinary Watercourse 36	1.46	4.87	11.50	2.80	0.50	0.00	Fail (322) (tier 1 only, assessed for GW impacts)	69%
S3 - OU17	Roman River	0.92	3.05	6.20	1.00	0.20	0.00	Pass	-
S3 - OU18	Roman River	0.29	0.94	0.80	0.00	0.00	0.00	Pass	-

Outfall Number	Receiving Watercourse	Annual Average Concentration related to EQS Compliance (ABC for Copper = 0.0µg/l): EQS Copper = 1.0µg/l and Zinc = 10.9µg/l		Acute Soluble Copper & Zinc Number of exceedances per year (RST exceedance limits in brackets)				Sediment Bound Pollutants (Pass / Fail)	Settlement required for sediments (where failure reported).
		Copper (µg/l)	Zinc (µg/l)	Copper RST24 (2)	Copper RST6 (1)	Zinc RST24 (2)	Zinc RST6 (1)		
S3 - OU19	Domsey Brook d/s	0.02	0.04	0.00	0.00	0.00	0.00	Pass	-
S3 - OU20	Unnamed Ditch	0.03	0.06	0.00	0.00	0.00	0.00	Pass	-
S3 - OU21	Ordinary Watercourse 23	1.35	4.46	10.60	2.60	0.50	0.00	Fail (281) (tier 1 only, assessed for GW impacts	65%
S3 - OU22	Ordinary Watercourse 23	0.19	0.42	0.20	0.00	0.00	0.00	Pass	-
S3 - OU23	Ordinary Watercourse 23	0.23	0.51	0.40	0.00	0.00	0.00	Pass (Alert D/S structure)	-
S3 - OU24	Ordinary Watercourse 23	0.41	0.92	0.80	0.20	0.00	0.00	Fail (149) (tier 1 only, assessed for GW impacts	33%
S3 - OU26	Ordinary Watercourse 37	1.01	3.32	6.90	1.40	0.40	0.00	Fail (182) (tier 1 only, assessed for GW impacts	46%

Outfall Number	Receiving Watercourse	Annual Average Concentration related to EQS Compliance (ABC for Copper = 0.0µg/l): EQS Copper = 1.0µg/l and Zinc = 10.9µg/l		Acute Soluble Copper & Zinc Number of exceedances per year (RST exceedance limits in brackets)				Sediment Bound Pollutants (Pass / Fail)	Settlement required for sediments (where failure reported).
		Copper (µg/l)	Zinc (µg/l)	Copper RST24 (2)	Copper RST6 (1)	Zinc RST24 (2)	Zinc RST6 (1)		
S3 - OU26A	Ordinary Watercourse 37	1.78	5.91	14.60	3.80	0.70	0.00	Fail (443) (tier 1 only, assessed for GW impacts	78%
S3 - OU26B	Ordinary Watercourse 38	0.27	0.88	0.80	0.00	0.00	0.00	Pass	-
S3 - OU27	Ordinary Watercourse 39	0.13	0.29	0.00	0.00	0.00	0.00	Pass	-
S3 - OU27A	Ordinary Watercourse 40	0.04	0.09	0.00	0.00	0.00	0.00	Pass	-
S3 - OU28	Ordinary Watercourse 39	0.09	0.20	0.00	0.00	0.00	0.00	Pass (Alert D/S structure)	-
S3 - OU29	Unnamed Ditch	0.21	0.47	0.20	0.00	0.00	0.00	Pass	-
S3 - OU30	Domsey Brook u/s	1.35	4.47	10.00	2.20	0.50	0.00	Pass (Tier 2)	-

Outfall Number	Receiving Watercourse	Annual Average Concentration related to EQS Compliance (ABC for Copper = 0.0µg/l): EQS Copper = 1.0µg/l and Zinc = 10.9µg/l		Acute Soluble Copper & Zinc Number of exceedances per year (RST exceedance limits in brackets)				Sediment Bound Pollutants (Pass / Fail)	Settlement required for sediments (where failure reported).
		Copper (µg/l)	Zinc (µg/l)	Copper RST24 (2)	Copper RST6 (1)	Zinc RST24 (2)	Zinc RST6 (1)		
S3 - OU30A	Domsey Brook u/s	1.31	4.36	9.70	2.00	0.50	0.00	Pass (Tier 2)	-
S3 - OU31	Unnamed Ditch	0.18	0.39	0.20	0.00	0.00	0.00	Pass	-
S3 - OU32	Ordinary Watercourse 41	0.24	0.54	0.50	0.00	0.00	0.00	Pass	-
S3 - OU33	Ordinary Watercourse 42	0.87	1.95	3.90	0.30	0.00	0.00	Fail (478) (tier 1 only, assessed for GW impacts	80%
IWR1	Existing Inworth Rd drainage but suspected to ultimately be Ordinary Watercourse 34	0.05	0.11	0.00	0.00	0.00	0.00	Pass	-

Outfall Number	Receiving Watercourse	Annual Average Concentration related to EQS Compliance (ABC for Copper = 0.0µg/l): EQS Copper = 1.0µg/l and Zinc = 10.9µg/l		Acute Soluble Copper & Zinc Number of exceedances per year (RST exceedance limits in brackets)				Sediment Bound Pollutants (Pass / Fail)	Settlement required for sediments (where failure reported).
		Copper (µg/l)	Zinc (µg/l)	Copper RST24 (2)	Copper RST6 (1)	Zinc RST24 (2)	Zinc RST6 (1)		
IWR2	Ordinary Watercourse 34	0.17	0.37	0.20	0.00	0.00	0.00	Pass	-
IWR3	Ordinary Watercourse 34	0.20	0.44	0.20	0.00	0.00	0.00	Pass	-
IWR4	Ordinary Watercourse 34	0.20	0.44	0.20	0.00	0.00	0.00	Pass	-
IWR5	Ordinary Watercourse 34C	0.08	0.18	0.00	0.00	0.00	0.00	Pass	-
IWR6	Ordinary Watercourse 34C	0.08	0.18	0.00	0.00	0.00	0.00	Pass	-
IWR7	Ordinary Watercourse 34C	0.05	0.12	0.00	0.00	0.00	0.00	Pass	-

Table C.2 HEWRAT routine runoff cumulative outfalls results for soluble impacts (Step 2 pre-mitigation)

Outfall Number	Receiving Watercourse	Annual Average Concentration related to EQS Compliance (ABC for Copper = 0.0µg/l): EQS Copper = 1.0µg/l and Zinc = 10.9µg/l		Soluble Copper & Zinc Number of exceedances/year (RST limits in brackets)				Sediment Bound Pollutants (Pass / Fail)
		Copper (µg/l)	Zinc (µg/l)	Copper RST24 (2)	Copper RST6 (1)	Zinc RST24 (2)	Zinc RST6 (1)	
S1 - OU07, OU7A	Ordinary Watercourse 2	0.86	2.00	4.20	0.50	0.00	0.00	n/a
S1 - OU12, OU10, OU10A, OU11	Boreham Brook	0.56	1.86	2.40	0.50	0.10	0.00	Pass
S1 - OU14, OU13A	Ordinary Watercourse 28	0.61	2.02	2.80	0.70	0.10	0.00	n/a
S1 - OU17, OU15, OU13	River Ter	0.21	0.7	0.5	0.00	0.00	0.00	n/a
S1 - OU19C, OU19C1	Ordinary Watercourse 7	0.42	0.93	0.80	0.10	0.00	0.00	Fail
S1 - OU19C, OU19C1, OU19[1]	Ordinary Watercourse 7	1.58	5.25	12.60	3.50	0.60	0.00	n/a
S2 - OU04 & OU05	River Brain	0.06	0.19	0.00	0.00	0.00	0.00	Pass
S2 - OU9 + OU10	Ordinary Watercourse 10	2.03	6.76	17.70	5.00	0.80	0.10	Fail

Outfall Number	Receiving Watercourse	Annual Average Concentration related to EQS Compliance (ABC for Copper = 0.0µg/l): EQS Copper = 1.0µg/l and Zinc = 10.9µg/l		Soluble Copper & Zinc Number of exceedances/year (RST limits in brackets)				Sediment Bound Pollutants (Pass / Fail)
		Copper (µg/l)	Zinc (µg/l)	Copper RST24 (2)	Copper RST6 (1)	Zinc RST24 (2)	Zinc RST6 (1)	
S2 - OU9, 0U9A + OU10[1]	Ordinary Watercourse 10	2.12	7.06	18.00	5.40	1.00	0.10	n/a
S2 - OU15A + OU14	Ordinary Watercourse 12	2.33	7.78	20.10	6.70	1.10	0.10	Fail
S2 - OU15A + OU14 + OU15E[1]	Ordinary Watercourse 12	2.48	8.27	21.90	7.50	1.20	0.30	n/a
S2 - OU15C + OU15D	Ordinary Watercourse 13	2.04	6.79	17.80	5.10	0.70	0.10	Fail
S2 - OU24 + OU24A	Rivenhall Brook	0.08	0.18	0.00	0.00	0.00	0.00	Pass (Alert D/S structure)
S2 - OU24 + OU24A + OU15G[1]	Rivenhall Brook	0.77	2.56	4.20	0.80	0.20	0.00	n/a
S2 – OU 18 + OU27 + OU19	River Blackwater	0.02	0.05	0.00	0.00	0.00	0.00	n/a
S2 - OU15H + OU26	Ordinary Watercourse 17	1.24	4.11	9.10	1.60	0.50	0.00	n/a

Outfall Number	Receiving Watercourse	Annual Average Concentration related to EQS Compliance (ABC for Copper = 0.0µg/l): EQS Copper = 1.0µg/l and Zinc = 10.9µg/l		Soluble Copper & Zinc Number of exceedances/year (RST limits in brackets)				Sediment Bound Pollutants (Pass / Fail)
		Copper (µg/l)	Zinc (µg/l)	Copper RST24 (2)	Copper RST6 (1)	Zinc RST24 (2)	Zinc RST6 (1)	
S3 - OU01 & OU05	River Blackwater	0.02	0.06	0.00	0.00	0.00	0.00	Pass
(S3 - OU02, OU05, OU01) + (S2 - OU18 & OU19)[1]	River Blackwater	0.06	0.19	0.00	0.00	0.00	0.00	n/a
S3 - OU06 & OU7A	Ordinary Watercourse 21a	0.16	0.52	0.20	0.00	0.00	0.00	Pass (Alert D/S Structure)
S3 - OU14, OU06 & OU7A[1]	Ordinary Watercourse 21a	0.24	0.79	0.70	0.00	0.00	0.00	n/a
S3 - OU08, OU19, OU09, OU10[1]	Domsey Brook d/s	0.48	1.58	2.10	0.50	0.00	0.00	n/a
S3 - OU08A, OU08, OU19, OU09[1]	Domsey Brook d/s	0.45	1.48	2.00	0.40	0.00	0.00	n/a
S3 -OU8C & OU8E	Existing Drainage (Inworth Rd ultimately Domsey Brook)	0.11	0.24	0.00	0.00	0.00	0.00	Pass (Alert D/S structure)
S3 - OU15, OU15B, OU15C	Ordinary Watercourse 26	0.72	2.37	4.00	0.80	0.20	0.00	n/a

Outfall Number	Receiving Watercourse	Annual Average Concentration related to EQS Compliance (ABC for Copper = 0.0µg/l): EQS Copper = 1.0µg/l and Zinc = 10.9µg/l		Soluble Copper & Zinc Number of exceedances/year (RST limits in brackets)				Sediment Bound Pollutants (Pass / Fail)
		Copper (µg/l)	Zinc (µg/l)	Copper RST24 (2)	Copper RST6 (1)	Zinc RST24 (2)	Zinc RST6 (1)	
S3 - OU17 & OU18	Roman River	1.07	3.56	7.40	1.40	0.20	0.00	n/a
S3 - OU21, OU22, OU23 & OU24	Ordinary Watercourse 23	2.02	6.70	16.80	5.10	0.80	0.00	n/a
S3 - OU26, OU26A	Ordinary Watercourse 37	2.15	7.14	18.30	5.80	0.90	0.20	n/a
S3 - OU27, OU28	Ordinary Watercourse 39	0.20	0.45	0.20	0.00	0.00	0.00	n/a
S3 - OU30A, OU30	Domsey Brook u/s	2.02	6.73	17.20	5.00	0.80	0.00	n/a
IWR1 to IWR7	Ordinary Watercourse 34	0.57	1.27	1.50	0.20	0.00	0.00	n/a

Table C.3 HEWRAT Step 3 (including mitigation) single outfall assessment results for outfalls assessed as groundwater to low flow watercourses

Outfall Number	Step 2 soluble pollutant assessment (pre-mitigation) result	Receiving Watercourse	Mitigation proposed	Step 3: EQS Compliance (ABC Cu = 0)		Step 3: Soluble Copper & Zinc Number of exceedances/year (RST limits in brackets)				Sediment Bound Pollutants (Deposition Index)	Settlement required (%)
				Copper (µg/l)	Zinc (µg/l)	Copper RST24 (2)	Copper RST6 (1)	Zinc RST24 (2)	Zinc RST6 (1)		
Single Outfalls											
S1 – OU07	Pass	Ordinary Watercourse 2	Passive Treatment	0.53	1.19	1.40	0.20	0.00	0.00	Fail (216)	54
S1 – OU07A	Pass	Ordinary Watercourse 2	Filter Drain (27.47%), Underground Storage Units (50%), Retention Pond	0.25	0.59	0.30	0.00	0.00	0.00	Pass (40)	-
S1 – OU14	Pass	Ordinary Watercourse 28	Passive Treatment	0.45	1.50	1.90	0.40	0.00	0.00	Pass (67)	-
S1 – OU13A	Pass	Ordinary Watercourse 28	Online Storage & Vegetated Ditch	0.09	0.20	0.00	0.00	0.00	0.00	Pass (22)	-

Outfall Number	Step 2 soluble pollutant assessment (pre-mitigation) result	Receiving Watercourse	Mitigation proposed	Step 3: EQS Compliance (ABC Cu = 0)		Step 3: Soluble Copper & Zinc Number of exceedances/year (RST limits in brackets)				Sediment Bound Pollutants (Deposition Index)	Settlement required (%)
				Copper (µg/l)	Zinc (µg/l)	Copper RST24 (2)	Copper RST6 (1)	Zinc RST24 (2)	Zinc RST6 (1)		
S1 – OU18	Fail (Copper RSTs & EQS and sediment-bound pollutants)	Ordinary Watercourse 31	Filter Drain (50% and Retention Pond)	0.83	2.54	4.20	0.50	0.00	0.00	Pass (83)	-
S1 – OU19	Fail (Cu RST24 & RST6 and Cu EQS)	Ordinary Watercourse 7	Cascading Retention Pond with two Basins	0.40	1.80	0.80	0.10	0.00	0.00	Pass (5)	-
S1 - OU19C	Pass	Ordinary Watercourse 7	Retention Pond	0.15	0.38	0.00	0.00	0.00	0.00	Pass (9)	-
S1 – OU19C1	Pass	Ordinary Watercourse 7	Retention Pond	0.14	0.37	0.20	0.00	0.00	0.00	Pass (9)	-
S1 – OU23 (+23C, 23D & 24A)	Fail (Cu RST24 & RST6 and Cu & Zn EQS)	Ordinary Watercourse 32	Filter Drain (17.96%) & Cascading Retention Pond with three Basins	0.66	3.32	0.70	0.10	0.00	0.00	Pass (78)	-

Outfall Number	Step 2 soluble pollutant assessment (pre-mitigation) result	Receiving Watercourse	Mitigation proposed	Step 3: EQS Compliance (ABC Cu = 0)		Step 3: Soluble Copper & Zinc Number of exceedances/year (RST limits in brackets)				Sediment Bound Pollutants (Deposition Index)	Settlement required (%)
				Copper (µg/l)	Zinc (µg/l)	Copper RST24 (2)	Copper RST6 (1)	Zinc RST24 (2)	Zinc RST6 (1)		
S1 – OU23C	Pass	Ordinary Watercourse 32	Retention Pond	0.15	0.38	0.00	0.00	0.00	0.00	Pass (31)	-
S1 – OU23D	Pass	Ordinary Watercourse 32	Filter Drain (12.93%) & Retention Pond	0.29	0.70	0.20	0.00	0.00	0.00	Pass (74)	-
S1 – OU24A	Pass	Ordinary Watercourse 32	Vegetated Ditch (90%) & Retention Pond	0.18	0.47	0.10	0.00	0.00	0.00	Pass (38)	-
S1 – OU24B	Pass	Ordinary Watercourse 32	Filter Drain (2.98%), Vegetated Ditch (75%), Retention Pond	0.24	0.60	0.20	0.00	0.00	0.00	Pass (52)	-
S2 – OU03	Pass	Ordinary Watercourse 9	Online Storage	0.44	1.45	1.70	0.30	0.00	0.00	Pass (64)	-
S2 – OU08	Fail (RST24 & RST6 Cu	Ordinary Watercourse 9a	Filter Drain (54%) and	16.90	4.70	0.40	0.00	1.92	4.86	Fail (349)	81%

Outfall Number	Step 2 soluble pollutant assessment (pre-mitigation) result	Receiving Watercourse	Mitigation proposed	Step 3: EQS Compliance (ABC Cu = 0)		Step 3: Soluble Copper & Zinc Number of exceedances/year (RST limits in brackets)				Sediment Bound Pollutants (Deposition Index)	Settlement required (%)
				Copper (µg/l)	Zinc (µg/l)	Copper RST24 (2)	Copper RST6 (1)	Zinc RST24 (2)	Zinc RST6 (1)		
	and EQS Cu)		Online Storage								
S2 – OU09	Fail (RST24 & RST6 Cu and Cu EQS)	Ordinary Watercourse 10	Filter Drain (30%) & Cascading Retention Pond with two Basins	0.61	2.41	1.50	0.10	0.00	0.00	Pass (58)	-
S2 – OU9A	Pass	Ordinary Watercourse 10	Filter Drain (53%) & Online Storage	0.32	0.81	0.80	0.00	0.00	0.00	Pass (32)	-
S2 – OU10	Pass	Ordinary Watercourse 10	Filter Drain (20%) & Retention Pond & Vegetated ditch	0.21	0.50	0.10	0.00	0.00	0.00	Pass (42)	-
S2 – OU11	Pass	Ordinary Watercourse 11	Retention Pond	0.23	0.60	0.20	0.00	0.00	0.00	Pass (55) (Alert downstream structure)	-

Outfall Number	Step 2 soluble pollutant assessment (pre-mitigation) result	Receiving Watercourse	Mitigation proposed	Step 3: EQS Compliance (ABC Cu = 0)		Step 3: Soluble Copper & Zinc Number of exceedances/year (RST limits in brackets)				Sediment Bound Pollutants (Deposition Index)	Settlement required (%)
				Copper (µg/l)	Zinc (µg/l)	Copper RST24 (2)	Copper RST6 (1)	Zinc RST24 (2)	Zinc RST6 (1)		
S2 - OU14	Fail (Sediment-bound pollutants)	Ordinary Watercourse 12a	Filter Drain (22%) & Retention Pond	0.25	0.59	0.20	0.00	0.00	0.00	Pass (42) (Alert downstream structure)	-
S2 – OU15A	Fail (Cu RST24 & RST6, Cu EQS and sediment-bound pollutants)	Ordinary Watercourse 12a	Filter Drain (11%) & Cascading Retention Pond with two Basins	0.41	1.25	0.20	0.00	0.00	0.00	Pass (68) (Alert downstream structure)	-
S2 – OU15C	Fail (Cu RST24 & RST6, Cu EQS and sediment-bound pollutants)	Ordinary Watercourse 13	Filter Drain (27%) & Cascading Retention Pond with two Basins	0.70	2.86	1.80	0.20	0.00	0.00	Pass (57) (Alert downstream structure)	-
S2 – OU15C1	Fail (Cu RST24)	Ordinary Watercourse 15a	Filter Drain (18%) & Retention Pond	0.27	0.96	0.70	0.00	0.00	0.00	Pass (22)	-

Outfall Number	Step 2 soluble pollutant assessment (pre-mitigation) result	Receiving Watercourse	Mitigation proposed	Step 3: EQS Compliance (ABC Cu = 0)		Step 3: Soluble Copper & Zinc Number of exceedances/year (RST limits in brackets)				Sediment Bound Pollutants (Deposition Index)	Settlement required (%)
				Copper (µg/l)	Zinc (µg/l)	Copper RST24 (2)	Copper RST6 (1)	Zinc RST24 (2)	Zinc RST6 (1)		
S2 – OU15D	Pass	Ordinary Watercourse 13	Retention Pond	0.09	0.23	0.00	0.00	0.00	0.00	Pass (17)	-
S2 – OU15E	Pass	Ordinary Watercourse 12a	Retention Pond	0.16	0.42	0.10	0.00	0.00	0.00	Pass (35) (Alert downstream structure)	-
S2 – OU26	Pass	Ordinary Watercourse 17	Passive Treatment	0.32	0.71	0.70	0.00	0.00	0.00	Fail (109)	9%
S3 -OU02	Fail (RST24 & RST6 Cu, EQS Cu and sediment-bound pollutants)	Ordinary Watercourse 21	Filter Drain (54.89%) & Cascading Retention Pond with two Basins	0.75	2.57	2.20	0.20	0.00	0.00	Pass (70)	-
S3 – OU03	Pass	Ordinary Watercourse 18	Retention Pond	0.11	0.29	0.00	0.00	0.00	0.00	Pass (23)	-

Outfall Number	Step 2 soluble pollutant assessment (pre-mitigation) result	Receiving Watercourse	Mitigation proposed	Step 3: EQS Compliance (ABC Cu = 0)		Step 3: Soluble Copper & Zinc Number of exceedances/year (RST limits in brackets)				Sediment Bound Pollutants (Deposition Index)	Settlement required (%)
				Copper (µg/l)	Zinc (µg/l)	Copper RST24 (2)	Copper RST6 (1)	Zinc RST24 (2)	Zinc RST6 (1)		
S3 – OU04	Pass	Ordinary Watercourse 21	Retention Pond	0.07	0.18	0.00	0.00	0.00	0.00	Pass (13)	-
S3 – OU06	Pass	Ordinary Watercourse 21a	Filter Drain (100%)	0.02	0.03	0.00	0.00	0.00	0.00	Pass (2)	-
S3 – OU07A	Pass	Ordinary Watercourse 21a	Filter Drain (100%)	0.06	0.07	0.00	0.00	0.00	0.00	Pass (6) (Alert downstream structure)	-
S3 – OU08B & 08D	Pass	Unnamed Ditch	Filter Drain (29.80%) & Retention Pond	0.11	0.25	0.00	0.00	0.00	0.00	Pass (18) (Alert downstream structure)	-
S3 - OU08C	Pass	Unnamed Ditch	Vegetated Ditch (47.06%) & Online Storage	0.03	0.07	0.00	0.00	0.00	0.00	Pass (9) (Alert downstream structure)	-
S3 - OU08E	Pass	Unnamed Ditch	Retention Pond	0.05	0.12	0.00	0.00	0.00	0.00	Pass (9) (Alert	-

Outfall Number	Step 2 soluble pollutant assessment (pre-mitigation) result	Receiving Watercourse	Mitigation proposed	Step 3: EQS Compliance (ABC Cu = 0)		Step 3: Soluble Copper & Zinc Number of exceedances/year (RST limits in brackets)				Sediment Bound Pollutants (Deposition Index)	Settlement required (%)
				Copper (µg/l)	Zinc (µg/l)	Copper RST24 (2)	Copper RST6 (1)	Zinc RST24 (2)	Zinc RST6 (1)		
										downstream structure)	
S3 – OU13	Pass	Ordinary Watercourse 35	Retention Pond	0.04	0.10	0.00	0.00	0.00	0.00	Pass (6) (Alert downstream structure)	-
S3 – OU14	Pass	Ordinary Watercourse 21a	Retention Pond	0.03	0.07	0.00	0.00	0.00	0.00	Pass (5)	-
S3 – OU15	Pass	Ordinary Watercourse 26	Passive Treatment	0.23	0.51	0.30	0.00	0.00	0.00	Pass (71) (Alert downstream structure)	-
S3 – OU15B	Pass	Ordinary Watercourse 26	Retention Pond	0.05	0.13	0.00	0.00	0.00	0.00	Pass (1) (Alert downstream structure)	-
S3 – OU15C	Pass	Ordinary Watercourse 26	Retention Pond	0.05	0.13	0.00	0.00	0.00	0.00	Pass (9) (Alert downstream structure)	-

Outfall Number	Step 2 soluble pollutant assessment (pre-mitigation) result	Receiving Watercourse	Mitigation proposed	Step 3: EQS Compliance (ABC Cu = 0)		Step 3: Soluble Copper & Zinc Number of exceedances/year (RST limits in brackets)				Sediment Bound Pollutants (Deposition Index)	Settlement required (%)
				Copper (µg/l)	Zinc (µg/l)	Copper RST24 (2)	Copper RST6 (1)	Zinc RST24 (2)	Zinc RST6 (1)		
S3 – OU16 & 15A	Fail (Cu RST24 & RST6 and Cu EQS)	Ordinary Watercourse 36	Filter Drain (32.98%) & Retention Pond	0.88	2.92	4.30	0.70	0.10	0.00	Fail (106)	69%
S3 – OU20	Pass	Unnamed Ditch	Swale	0.01	0.03	0.00	0.00	0.00	0.00	Pass (1)	-
S3 – OU21	Fail (Cu RST24 & RST6 and Cu EQS)	Ordinary Watercourse 23	Cascading Retention Pond with two basins	0.49	2.19	1.00	0.10	0.00	0.00	Pass (45) (Alert downstream structure)	-
S3 – OU22	Pass	Ordinary Watercourse 23	Retention Pond	0.11	0.29	0.00	0.00	0.00	0.00	Pass (22)	-
S3 – OU23	Pass	Ordinary Watercourse 23	Retention Pond	0.14	0.35	0.00	0.00	0.00	0.00	Pass (28) (Alert downstream structure)	-
S3 – OU24	Pass	Ordinary Watercourse 23	Filter Drain (23.44%) & Retention Pond	0.58	0.25	0.20	0.00	0.00	0.00	Pass (52) (Alert downstream structure)	-

Outfall Number	Step 2 soluble pollutant assessment (pre-mitigation) result	Receiving Watercourse	Mitigation proposed	Step 3: EQS Compliance (ABC Cu = 0)		Step 3: Soluble Copper & Zinc Number of exceedances/year (RST limits in brackets)				Sediment Bound Pollutants (Deposition Index)	Settlement required (%)
				Copper (μg/l)	Zinc (μg/l)	Copper RST24 (2)	Copper RST6 (1)	Zinc RST24 (2)	Zinc RST6 (1)		
S3 – OU26	Fail (Cu RST24 & RST6 and Cu EQS)	Ordinary Watercourse 37	Filter Drain (42.56%) & Retention Pond	0.60	1.89	2.20	0.20	0.00	0.00	Pass (55)	-
S3 – OU26A	Fail (Cu RST24 & RST6 and Cu EQS)	Ordinary Watercourse 37	Filter Drain (85.95%) & Cascading Retention Pond with two basins & Vegetated outfall	0.55	1.54	1.20	0.10	0.00	0.00	Pass (27)	-
S3 – OU27	Pass	Ordinary Watercourse 39	Retention Pond	0.08	0.20	0.00	0.00	0.00	0.00	Pass (15)	-
S3 – OU27A	Pass	Ordinary Watercourse 40	Swale	0.02	0.05	0.00	0.00	0.00	0.00	Pass (2)	-
S3 – OU28	Pass	Ordinary Watercourse 39	Swale	0.04	0.10	0.00	0.00	0.00	0.00	Pass (5) (Alert downstream structure)	-

Outfall Number	Step 2 soluble pollutant assessment (pre-mitigation) result	Receiving Watercourse	Mitigation proposed	Step 3: EQS Compliance (ABC Cu = 0)		Step 3: Soluble Copper & Zinc Number of exceedances/year (RST limits in brackets)				Sediment Bound Pollutants (Deposition Index)	Settlement required (%)
				Copper (µg/l)	Zinc (µg/l)	Copper RST24 (2)	Copper RST6 (1)	Zinc RST24 (2)	Zinc RST6 (1)		
S3 – OU29	Pass	Unnamed Ditch	Retention Pond	0.13	0.33	0.00	0.00	0.00	0.00	Pass (27)	-
S3 – OU31	Pass	Unnamed Ditch	Retention Pond	0.11	0.27	0.00	0.00	0.00	0.00	Pass (21)	-
S3 – OU32	Pass	Ordinary Watercourse 41	Retention Pond	0.15	0.38	0.00	0.00	0.00	0.00	Pass (31)	-
S3 – OU33	Fail (Cu RST24)	Ordinary Watercourse 42	Retention Pond	0.52	1.37	1.00	0.10	0.00	0.00	Fail (191)	80%

Table C.4 HEWRAT Step 3 (including mitigation) cumulative outfall assessment results for outfalls assessed as groundwater to low flow watercourses

1 **To identify whether outfalls are within 1km of each other, measurements have started from the furthest downstream outfall. Therefore, some outfalls appear more than once and are subject to separate cumulative assessments.**

Outfall Number	Step 2 soluble pollutant assessment (pre-mitigation)	Receiving Watercourse	Mitigation proposed	Step 3: EQS Compliance (ABC Cu = 0)		Step 3: Soluble Copper & Zinc Number of exceedances/year (RST limits in brackets)				Step 3 Sediment-bound pollutants
				Copper (µg/l)	Zinc (µg/l)	Copper RST24 (2)	Copper RST6 (1)	Zinc RST24 (2)	Zinc RST6 (1)	
S1 - OU07, OU7A	Fails Cu RST24	Ordinary Watercourse 2	Passive treatment, Filter Drain and Attenuation Pond	0.74	1.74	3.00	0.30	0.00	0.00	n/a
S1 - OU14, OU13A	Fails Cu RST24	Ordinary Watercourse 28	Passive treatment and Vegetated Ditch	0.59	1.94	2.60	0.60	0.10	0.00	n/a
S1 - OU19C, OU19C1[1]	Pass	Ordinary Watercourse 7	Attenuation Ponds	0.25	0.65	0.20	0.00	0.00	0.00	Pass
S1 - OU19C, OU19C1, OU19[1]	Fails Cu RST24, Cu RST6 and Cu EQS	Ordinary Watercourse 7	Double Attenuation Pond and Attenuation Ponds	0.74	3.05	2.90	0.20	0.20	0.00	n/a

Outfall Number	Step 2 soluble pollutant assessment (pre-mitigation)	Receiving Watercourse	Mitigation proposed	Step 3: EQS Compliance (ABC Cu = 0)		Step 3: Soluble Copper & Zinc Number of exceedances/year (RST limits in brackets)				Step 3 Sediment-bound pollutants
				Copper (µg/l)	Zinc (µg/l)	Copper RST24 (2)	Copper RST6 (1)	Zinc RST24 (2)	Zinc RST6 (1)	
S2 - OU9 + OU10[1]	Fails Cu RST24, Cu RST6 and Cu EQS	Ordinary Watercourse 10	Filter Drains, Attenuation Pond, Vegetated Ditch	0.83	3.11	2.90	0.30	0.00	0.00	Pass (Alert D/S structure)
S2 - OU9, 0U9A + OU10[1]	Fails Cu RST24, Cu RST6 and Cu EQS	Ordinary Watercourse 10	Filter Drains, Online Storage, Attenuation Pond, Vegetated Ditch	0.95	3.39	4.60	0.40	0.10	0.00	n/a
S2 - OU15A + OU14[1]	Fails Cu RST24, Cu RST6 and Cu EQS	Ordinary Watercourse 12	Filter Drains & Attenuation Ponds	0.98	3.97	4.70	0.40	0.30	0.00	Fail
S2 - OU15A + OU14 + OU15E[1]	Fails Cu RST24, Cu RST6 and Cu EQS	Ordinary Watercourse 12	Filter Drains & Attenuation Ponds	1.09	4.38	5.40	0.40	0.30	0.00	n/a

Outfall Number	Step 2 soluble pollutant assessment (pre-mitigation)	Receiving Watercourse	Mitigation proposed	Step 3: EQS Compliance (ABC Cu = 0)		Step 3: Soluble Copper & Zinc Number of exceedances/year (RST limits in brackets)				Step 3 Sediment-bound pollutants
				Copper (µg/l)	Zinc (µg/l)	Copper RST24 (2)	Copper RST6 (1)	Zinc RST24 (2)	Zinc RST6 (1)	
S2 - OU15C + OU15D	Fails Cu RST24, Cu RST6 and Cu EQS	Ordinary Watercourse 13	Filter Drains & Attenuation Ponds	0.77	3.13	2.30	0.20	0.00	0.00	n/a
S2 - OU15H + OU26	Fails Cu RST24, Cu RST6 and Cu EQS	Ordinary Watercourse 17	Attenuation Pond and Online Storage	0.96	3.45	5.90	1.00	0.20	0.00	n/a
S3 - OU06 & OU7A[1]	Pass	Ordinary Watercourse 21a	Filter Drain	0.16	0.28	0.20	0.00	0.00	0.00	Pass (Alert D/S Structure)
S3 - OU14, OU06 & OU7A[1]	Pass	Ordinary Watercourse 21a	Filter Drains & Attenuation Pond	0.22	0.45	0.50	0.00	0.00	0.00	n/a
S3 - OU15, OU15B, OU15C	Fails Cu RST24	Ordinary Watercourse 26	Passive Treatment & Attenuation Ponds	0.61	2.11	2.60	0.60	0.10	0.00	n/a

Outfall Number	Step 2 soluble pollutant assessment (pre-mitigation)	Receiving Watercourse	Mitigation proposed	Step 3: EQS Compliance (ABC Cu = 0)		Step 3: Soluble Copper & Zinc Number of exceedances/year (RST limits in brackets)				Step 3 Sediment-bound pollutants
				Copper (µg/l)	Zinc (µg/l)	Copper RST24 (2)	Copper RST6 (1)	Zinc RST24 (2)	Zinc RST6 (1)	
S3 - OU21, OU22, OU23 & OU24	Fails Cu RST24, Cu RST6 and Cu EQS	Ordinary Watercourse 23	Filter Drains & Attenuation Ponds	0.97	4.02	4.50	0.40	0.30	0.00	n/a
S3 - OU26, OU26A	Fails Cu RST24, Cu RST6 and Cu EQS	Ordinary Watercourse 37	Filter Drains, Attenuation Ponds & Vegetated outfall	0.86	2.50	3.40	0.20	0.00	0.00	n/a
S3 - OU27, & OU28	Pass	Ordinary Watercourse 39	Swale and Attenuation Ponds	0.12	0.28	0.00	0.00	0.00	0.00	n/a
IWR1 to IWR7 (all Inworth Road catchments)	Pass	Ordinary Watercourse 34	Attenuation Ponds & Ditches (passive treatment)	0.43	1.04	0.8	0.1	0.00	0.00	n/a

Table C.5 HEWRAT results for existing outfalls to surface waters (excludes low flow watercourses)

Outfall	Receiving Watercourse	Step 2: EQS Compliance (ABC Cu = 0)		Step 2: Soluble Copper & Zinc Number of exceedances/year (RST limits in brackets)				Sediment-bound Pollutants (Pass/Fail)
		Copper (µg/l)	Zinc (µg/l)	Copper RST24 (2)	Copper RST6 (1)	Zinc RST24 (2)	Zinc RST6 (1)	
S1 – OU01	River Chelmer	0.01	0.03	0.00	0.00	0.00	0.00	Pass
S1 – OU10	Boreham Brook	0.03	0.08	0.00	0.00	0.00	0.00	Pass
S1 – OUO10A	Boreham Brook	0.00	0.00	0.00	0.00	0.00	0.00	Pass
S1 – OU12	Boreham Brook	0.23	0.54	0.50	0.00	0.00	0.00	Pass
S1 – OU13	River Ter	0.01	0.01	0.00	0.00	0.00	0.00	Pass
S1 – OU15	River Ter	0.06	0.14	0.00	0.00	0.00	0.00	Pass
S1 – OU17	Ordinary Watercourse 31	0.07	0.16	0.00	0.00	0.00	0.00	Pass
S2 – OU04	River Brain	0.02	0.04	0.00	0.00	0.00	0.00	Pass
S2 – OU05	River Brain	0.01	0.02	0.00	0.00	0.00	0.00	Pass
S2 – OU17	Existing Drainage	0.12	0.26	0.00	0.00	0.00	0.00	Pass
S2 – OU18	River Blackwater	0.00	0.00	0.00	0.00	0.00	0.00	Pass
S2 – OU19	River Blackwater	0.00	0.01	0.00	0.00	0.00	0.00	Pass
S2 – OU24	Rivenhall Brook	0.10	0.21	0.00	0.00	0.00	0.00	Pass (Alert D/S Structure)
S3 – OU01	River Blackwater	0.01	0.01	0.00	0.00	0.00	0.00	Pass

Outfall	Receiving Watercourse	Step 2: EQS Compliance (ABC Cu = 0)		Step 2: Soluble Copper & Zinc Number of exceedances/year (RST limits in brackets)				Sediment-bound Pollutants (Pass/Fail)
		Copper (µg/l)	Zinc (µg/l)	Copper RST24 (2)	Copper RST6 (1)	Zinc RST24 (2)	Zinc RST6 (1)	
S3 – OU05	River Blackwater	0.00	0.00	0.00	0.00	0.00	0.00	Pass
S3 – OU08	Domsey Brook d/s	0.03	0.06	0.00	0.00	0.00	0.00	Pass
S3 – OU09	Domsey Brook d/s	0.01	0.03	0.00	0.00	0.00	0.00	Pass (Alert D/S Structure)
S3 – OU16	Ordinary Watercourse 36	0.74	1.72	3.40	0.30	0.00	0.00	Fail
S3 – OU17	Roman River	0.79	2.63	4.50	0.80	0.20	0.00	Pass
S3 – OU18	Roman River	0.14	0.33	0.00	0.00	0.00	0.00	Pass
S3 – OU19	Domsey Brook d/s	0.00	0.01	0.00	0.00	0.00	0.00	Pass

Annex D Detailed level assessment using M-BAT

D.1.1 The Water Environment (Water Framework Directive) Regulations (2017) require that all inland and coastal waters achieve ‘good’ water quality status by 2027. One of the measures used to deliver this requirement are Environmental Quality Standards (EQS). An EQS is the concentration of a chemical in the environment below which there is not expected to be an adverse effect on the specific endpoint being considered, e.g., the protection of aquatic life. A water body cannot achieve good status if the EQS for any Priority/Priority Hazardous Substance or Specific Pollutant, is exceeded.

D.1.2 The toxicity of metals is dependent on a range of water quality parameters including water hardness, pH and dissolved organic carbon (DOC). These parameters influence the amount of metal that is actually bioavailable. This bioavailability fraction of the metal is responsible for toxic effects in flora and fauna. EQS limits for a number of metals have been established based on their bioavailable concentration. They are derived to reflect concentrations of concern in conditions of high bioavailability and are referred to as $EQS_{bioavailable}$.

D.1.3 The bioavailability of a metal depends on several physico-chemical factors, which governs both metal behaviour and the interactions of the toxic forms of the metals with a biological receptor. For example, if the metal ions bind to carbonate ions or DOC, they are less ‘bioavailable’ and thus less likely to be able to bind to the organism and have an adverse effect.

D.1.4 The output from the M-BAT tool has been used to determine the maximum total copper concentration output that would still pass from the HEWRAT assessment. The total copper concentration is assessed in HEWRAT with the average ambient copper concentrations and considering other water quality factors. This value leads to the maximum permitted bioavailable copper concentration of 1.0 µg/l.

D.1.5 From the results, the watercourses with the greater concentration of DOC are the watercourses where there may be a greater concentration of total copper within the stream before the permitted limit of 1.0 µg/l bioavailable copper is reached.

D.1.6 To determine the bioavailable concentration of a metal directly the M-BAT for copper (Cu), zinc (Zn), manganese (Mn) and nickel (Ni) has been used as described in the 'UKTAG River and Lake Assessment Method Specific Pollutants (Metals): Metal Bioavailability Assessment Tool (M-BAT) guidance (UK Technical Advisory Group on the Water Framework Directive, July 2014). The key output of the M-BAT is an estimate of the bioavailable concentration of a metal under the conditions found at a site, which can then be compared with the $EQS_{bioavailable}$ to assess compliance. M-BAT is applicable to all UK freshwaters.

D.1.7 The outputs from M-BAT can be used in one of two ways: -

- To assess compliance with an $EQS_{bioavailable}$ and undertake classification
- To estimate the risk characterization ratio of a location to metal inputs – considering the relevant water quality parameter at the site, i.e. pH, DOC and calcium.

D.1.8 The M-BAT determines the bioavailability of certain metals through the use of local water chemistry data, specifically pH, DOC (mg/l) and Calcium (mg/l). The M-BAT guidance (UK-TAG, 2014) suggests that the input values for each of the three parameters can be either an individual sample result or a summary value derived from sampling results for a relevant time period. For both pH and calcium where a summary value is used the average is required but for DOC the median value is required. The dissolved metal concentration which is included in the tool can be added as an individual sample result or as a summary value, e.g., the average of available data for the time period being considered. The M-BAT guidance (UK-TAG, 2014) also suggests that where associated data is not available then relevant data for the site, e.g., previous monitoring data or data from similar sites, can be used to give an indication of levels.

D.2 EQS compliance assessment

D.2.1 The M-BAT also calculates the bioavailability factor (BioF) which is based on a comparison between the expected bioavailability at the reference site and that relating to site-specific conditions. An estimate of bioavailable copper and zinc can be calculated by multiplying copper or zinc concentration results generated by HEWRAT, by the BioF. This in turn generates a new value of concentration against which EQS compliance can be measured. The BioF is calculated in M-BAT by dividing the Generic or Reference EQS by the calculated site-specific EQS.

D.2.2 In addition, the risk characterisation ratio (RCR) is calculated and provides an indication of whether the site being assessed has passed or failed the EQS and by what extent. The RCR is calculated by comparing the bioavailable concentration determined with the $EQS_{bioavailable}$. Where the RCR is greater than 1 this indicates the bioavailable concentration is above the EQS and therefore at risk.

D.2.3 As stated in the UK-TAG guidance a further output is the $PNEC_{dissolved}$. This is the Predicted No Effect Concentration (PNEC). This concentration is derived from the ecotoxicological data and site-specific water quality data using M-BAT. The site specific $PNEC_{dissolved}$ can be considered a site specific EQS (expressed as dissolved concentration).

D.2.4 The M-BAT has been developed and validated for particular ranges of pH, Ca and DOC. If any of the input parameters fall outside the validated ranges the relevant boundary value, either the upper or lower value is used as a substitute. The operating ranges for pH, Calcium and DOC for each of the component of M-BAT, i.e. copper, zinc, manganese and nickel are shown in Table D.1.

Table D.1 Operating ranges of the models within M-BAT

	pH	Calcium (mg/l)	DOC (mg/l)
Copper	6 – 8.5	3.1 – 93	Upper value of 15mg/l
Zinc	6 – 8	3 – 160	Upper value of 20mg/l
Manganese	5.5 – 8.5	1 – 200	Upper value of 20mg/l
Nickel	6.5 – 8.7	2 - 88	Upper value of 20mg/l

D.2.5 Background concentrations can also be considered for metals when assessing monitoring results against the EQS. Metals occur naturally in the aquatic environment due to weathering of surface geology. Natural background concentrations are therefore determined by local geology. The general definition of natural background level is the concentration that is present owing to natural and geological processes only, i.e. the background level with no anthropogenic contribution. However, in reality truly pristine areas are rare within Europe and inevitably any estimate of natural background concentration will include a contribution from anthropogenic sources because of inputs from historical anthropogenic activity, e.g., mining. This anthropogenic input is hard to quantify and distinguish from naturally occurring levels and therefore in reality any assessment of a background concentration will be an ABC.

D.2.6 The M-BAT guidance (UK-TAG, 2014) states that for most metals, the local background concentration would be accounted for only if there is a failure of the EQS. During an investigation of an EQS failure, consideration should be given to the potential influence of ABCs at the particular site being studied. Suitable ABCs should therefore use information from e.g., headwaters or neighbouring sites to estimate a local ABC. The assessment which previously failed for EQS copper at Step 3 HEWRAT has been re-run in HEWRAT with this ABC, and an increased EQS value has been calculated to account for the ABC and the runoff from the scheme.

D.2.7 The ABC value for copper used in the HEWRAT assessments has been based upon the Environment Agency’s Water Quality Archive Service (EA WIMS) sampling data collected from the River Blackwater (Feeringbury Old Mill) sampling point (Plate D.1 and Table D.3). Based upon this data the ABC value for copper used in the HEWRAT assessments is 2.36 µg/l.

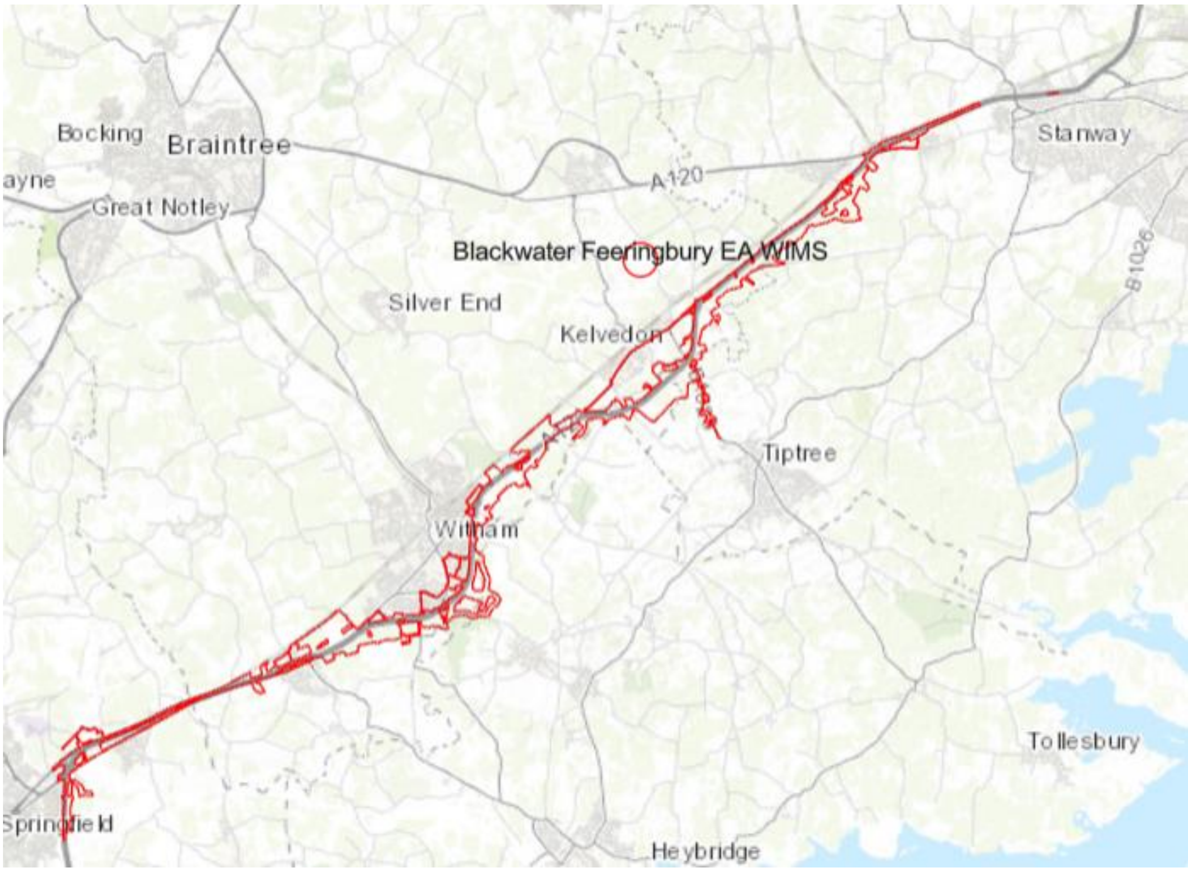
D.2.8 The results for the HEWRAT assessments run with the ABC copper value for Step 2 and Step 3 are presented in Table D.2. The EQS values from the Step 3 results in Table D.2 have been used in the M-BAT assessment. This represents the total concentration of dissolved copper within the watercourse (i.e. from the routine runoff discharge and the background levels within the watercourse).

Table D.2 HEWRAT total copper EQS results with copper ABC.

Outfall Number	Receiving Watercourse	Annual Average Concentration related to Copper EQS Compliance (ABC for Copper = 2.36µg/l): EQS Copper = 1.0µg/l	
		Step 2 Total copper (µg/l)	Step 3 Total copper (µg/l)
S2 - OU15A, OU14, OU15E	Ordinary Watercourse 12	4.73	3.34

D.3 M-BAT input data

D.3.1 M-BAT assessments have been applied to the outfalls failing for EQS copper at HEWRAT Step 3 using water quality data from the EA sampling location on the River Blackwater. Outfalls within the River Blackwater catchment have been assessed with data from the Feeringbury Old Mill sampling point available from the Environment Agency Water Quality Archive (Environment Agency WIMS website, accessed 1 December 2021) and these are shown in Plate D.1.



D.4 River Blackwater

D.4.1 The River Blackwater has an EA sampling point at Feeringbury Old Mill (site ID AN-BL04) at NGR 586447 221180, upstream of Feering and the existing A12. The River Blackwater joins with the River Chelmer at the Blackwater estuary at the west end of the scheme. Given that Watercourse 12 is a tributary of the River Blackwater and thus in the same catchment as the Environment Agency sampling site, it is assumed that the data from the River Blackwater (Feeringbury Old Mill) sampling point are representative of water chemistry characteristics across the wider catchment.

D.4.2 The sampled data collected between 2015 and 2021 for pH, DOC, Ca, Cu and Zn is presented in Table D.3. This data is summarised as average, maximum, minimum and median values in Table D.4.

Table D.3 River Blackwater at Feeringbury Old Mill sampling data

Sampling Date & Time	Cu (ug/l)	Zn (ug/l)	pH	DOC (mg/)	Ca (mg/l)
2021 Data					
01/11/2021 09:11	-	-	8.03	-	-
12/10/2021 12:04	-	-	7.88	-	-

Sampling Date & Time	Cu (ug/l)	Zn (ug/l)	pH	DOC (mg/)	Ca (mg/l)
07/09/2021 13:22	-	-	7.96	-	-
05/08/2021 11:48	-	-	8.08	-	-
08/06/2021 09:04	-	-	8.1	-	-
13/05/2021 13:04	-	-	8.67	-	-
2020 Data					
02/03/2020 09:34	-	-	8.16	5.5	-
2019 Data					
05/12/2019 15:08	-	-	8.24	5	150
25/09/2019 08:44	-	-	8.15	4.1	120
10/06/2019 09:23	-	-	7.94	4.84	118
13/05/2019 15:08	-	-	8.31	-	-
18/03/2019 16:23	-	-	8.32	4.62	131
04/02/2019 15:21	-	-	8.09	-	-
2018 Data					
11/12/2018 15:22	-	-	7.98	4.83	140
10/10/2018 15:59	-	-	8.01	-	-
06/09/2018 13:23	-	-	7.93	4.19	126
03/07/2018 09:14	-	-	7.96	-	-
07/06/2018 13:11	-	-	8.18	4.26	126
09/04/2018 14:46	-	-	8.06	-	-
05/03/2018 16:06	-	-	8	5.5	108
08/01/2018 09:06	-	-	8.13	-	-
2017 Data					
06/12/2017 13:34	-	-	7.95	3.95	130
21/09/2017 13:39	-	-	7.99	3.84	127
21/09/2017 13:38	-	-	7.99	-	-
05/06/2017 13:10	-	-	7.93	4.95	103
28/03/2017 15:26	2.25	1.84	8.47	4.97	146
21/02/2017 14:57	2.13	1.76	8.3	4.62	152

Sampling Date & Time	Cu (ug/l)	Zn (ug/l)	pH	DOC (mg/)	Ca (mg/l)
09/01/2017 09:53	2.22	2.56	8.44	5.72	152
2016 Data					
13/12/2016 13:05	2.02	2.1	8.04	5.24	154
23/11/2016 14:54	2.86	1.85	8.11	6.8	128
01/11/2016 14:24	1.87	1.46	7.99	4.03	132
19/10/2016 14:08	1.76	1.85	8.12	4.03	135
28/09/2016 14:08	2.22	2.81	7.97	4.22	133
31/08/2016 14:42	2.53	1.87	7.63	4.24	129
11/07/2016 14:09	2.2	1.96	8.16	4.34	134
21/06/2016 12:06	3.51	1.95	8.03	7.48	98.5
08/06/2016 15:51	2.69	2.04	8.18	4.85	125
11/03/2016 11:44	-	-	8.24	5.35	121
08/02/2016 08:43	-	-	8	-	-
2015 Data					
03/12/2015 14:54	-	-	8.13	6.28	124
13/10/2015 15:40	-	-	7.92	-	-
03/09/2015 13:37	-	-	7.85	4.59	112
14/07/2015 09:34	-	-	7.86	-	-

Table D.4 Summary values of Environment Agency sampling data at Feeringbury Old Mill on the River Blackwater

Parameter	Average	Maximum	Minimum	Median
pH	8.08	8.67	7.63	8.04
DOC (mg/l)	4.90	7.48	3.84	4.83
Ca (mg/l)	129.02	154.00	98.50	128.50
Cu (ug/l)	2.36	3.51	1.76	2.22
Zn (ug/l)	2.00	2.81	1.46	1.91

D.5 M-BAT results

D.5.1 Based on the summary data from Table D.3 (average pH, average Ca and median DOC) M-BAT has been applied to the River Blackwater and results are presented in Table D.5. As the Calcium input values for the River Blackwater exceeds 93 mg/l, the calculation for dissolved coper was run with the maximum Ca input of 93 mg/l. The River Blackwater pH input exceeds 8, and so is set to this maximum value for the dissolved zinc calculation.

D.5.2 The average copper concertation from the River Blackwater (Feeringbury Old Mill) sampling point is 2.36 ug/l. This River Blackwater value has been used as the ABC for copper in the HEWRAT assessments to inform the M-BAT assessments.

Table D.5 M-BAT results for River Blackwater

	River Blackwater Feeringbury Old Mill		
Input Parameters	**pH (average)**	**DOC (mg/l) (median)**	**Ca (mg/l) (average)**
Data used	8.08	4.83	129.02
M-BAT result	**Site-specific PNEC Dissolved (µg l^{-1})**		**BioF**
Copper	13.54		0.07
Zinc	28.89		0.38
Manganese	188.05		0.65
Nickel	9.63		0.42

D.5.3 The results show the PNEC and BioF values for each assessed metal. The PNEC value is derived from site-specific water quality data, and so is the total dissolved concentration for a metal at which point the bioavailable concentration of that metal equals the EQS threshold value. For example, for the River Blackwater, where the PNEC for dissolved copper is 13.54 ug/l, 1.0 ug/l will be bioavailable, and meeting the EQS value. Therefore, the PNEC value can be considered a site specific EQS value. BioF is the bioavailability factor for the specific site, for example where the River Blackwater has a 0.07 BioF value for copper, for every 1.0 ug/l of dissolved copper at that location, 0.07 ug/l is predicted to be bioavailable.

D.5.4 The PNEC values for the River Blackwater are 13.54 ug/l for dissolved copper and 28.89 ug/l for dissolved zinc.

D.5.5 A PDF screenshot of all the assessments undertaken using M-BAT is presented in Table D.7.

D.6 Routine runoff detailed assessment - M-BAT assessment

D.6.1 Of all single and cumulative outfall assessments undertaken, one cumulative assessment (S2 - OU15A + OU14 + OU15E) recorded an exceedance of the copper EQS threshold of 1.0 µg/l after Step 3 (1.09 µg/l) in HEWRAT, without the ABC for copper included. These outfalls are to Watercourse 12, a low flow watercourse and thus the magnitude of impact has been determined by the groundwater assessment results. However, as the surface water assessment of this discharge has recorded an EQS failure and to inform the groundwater assessment a detailed level assessment has been undertaken using M-BAT.

D.6.2 Where the HEWRAT EQS value is less than the PNEC values, this is considered a pass. Within Table D.6, a traffic light system has been used to aid interpretation: green shading indicates a ‘pass’, and red shading indicates ‘fail’ against the PNEC values. The M-BAT assessment result shows bioavailable concentration for copper for the cumulative assessment for outfalls S2 - OU15A, OU14, OU15E (0.24 µg/l) is below the 1.0 µg/l EQS limit for bioavailable copper.

Table D.6 HEWRAT and M-BAT results

Outfall Number.	Receiving watercourse	M-BAT Site-specific PNEC Dissolved Copper (µg/l)	HEWRAT Step 3 Total EQS Copper Annual Average Concentrations (µg/l) (with ABC Cu at 2.36 µg/l)	BioF	Bioavailable Copper Concentration (µg/l) (HEWRAT Predicted EQS x BioF)
Cumulative Outfall Assessments					
S2 - OU15A, OU14, OU15E	Ordinary Watercourse 12 (Tributary of River Blackwater)	13.54	3.34	0.07	0.24

D.6.3 The site-specific PNEC Dissolved copper concentration has been calculated as 13.54 µg/l and HEWRAT total calculated copper EQS results both at Step 2 (4.73 µg/l) and Step 3 (3.34 µg/l) are both less than this value. When the BioF of 0.07 is considered, the calculated bioavailable copper at both Step 2 (4.73 x 0.07 = 0.33 µg/l) and Step 3 (3.34 x 0.07 = 0.24 µg/l) also both pass copper EQS threshold of 1.0 µg/l.

D.6.4 In addition, the highest copper EQS concentration calculated by HEWRAT for all (single and cumulative) assessments undertaken (inclusive of Step 2 and Step 3 results), was 3.32 µg/l (without ABC) and 5.53 µg/l (with ABC of 2.36 µg/l) (for S1 – OU23 at Step 2). These concentrations are well below the site-specific PNEC of 13.54 µg/l. Consequently, all reported copper EQS results from Step 3 assessments can be accepted as 'Pass'.

D.6.5 Based upon the M-BAT analysis it can be concluded that all outfalls will achieve legal compliance of the EQS standards before mitigation is considered and with the ABC for copper included. Any mitigation provided for the short-term impacts (i.e. RSTs) will also provide a betterment against the legal requirements for the EQS for copper and zinc.

Table D.7 Screenshot of M-BAT analysis undertaken

ID	Location	Waterbody	Date	Measured Cu Concentration (dissolved) ($\mu g\ l^{-1}$)	Measured Zn Concentration (dissolved) ($\mu g\ l^{-1}$)	Measured Mn Concentration (dissolved) ($\mu g\ l^{-1}$)	Measured Ni Concentration (dissolved) ($\mu g\ l^{-1}$)	pH	DOC	Ca	Site-specific PNEC Dissolved Copper ($\mu g\ l^{-1}$)	BioF	Bioavailable Copper Concentration ($\mu g\ l^{-1}$)	Risk Characterisation Ratio	Site-specific PNEC Dissolved Zinc ($\mu g\ l^{-1}$)	BioF	Bioavailable Zinc Concentration ($\mu g\ l^{-1}$)	Risk Characterisation Ratio
1	S2 - OU15A, OU14A, OU15E (ABC 2.36) Step 2 Cu EQS	Ordinary Watercourse 12	31/01/2022	4.73				8.08	4.83	129.02	13.54	0.07	0.35	0.35	28.89	0.38		
2	S2 - OU15A, OU14A, OU15E (ABC 2.36) Step 3 Cu EQS	Ordinary Watercourse 12	31/01/2022	3.34				8.08	4.83	129.02	13.54	0.07	0.25	0.25	28.89	0.38		
3	S1 - OU23 (ABC 2.36) Step 2 Cu EQS	Ordinary Watercourse 32	31/01/2022	5.53				8.08	4.83	129.02	13.54	0.07	0.41	0.41	28.89	0.38		

Annex E Proposed mitigation / SuDS treatment trains

E.1.1 The proposed mitigation/SuDS treatment trains associated with each individual outfall for the proposed scheme are detailed below in Table E.1.

Table E.1 Proposed mitigation / SuDS treatment trains for individual outfalls

Outfall number	Receiving watercourse	Proposed mitigation / SuDS treatment	Total Treatment efficiencies (%) used for proposed mitigation / SuDS treatment		
			Copper	Zinc	Total Suspended Solids (TSS)
Design section 1 (S1) of the proposed scheme, beyond A12 Junction 18 to beyond A12 Junction 21					
OU01	River Chelmer	Filter Drain (41.91%), Underground Storage Units, Attenuation Pond (95%)	38	41	67
OU07	Ordinary Watercourse 2	Passive Treatment	0	0	0
OU07A	Ordinary Watercourse 2	Filter Drain (27.47%), Underground Storage Units (50%), Attenuation Pond	40	38	66
OU10	Boreham Brook	Filter Drains (3.34%), Underground storage units	0	1	2
OU10A	Boreham Brook	Underground storage units	0	0	0
OU11	Boreham Brook	Filter Drain (68.54%) & Attenuation Pond	40	51	76
OU12	Boreham Brook	Filter Drain (8.24%) & Attenuation Pond	40	32	61
OU13	River Ter	Filter Drain (33.31%) & Attenuation Pond	40	40	67

Outfall number	Receiving watercourse	Proposed mitigation / SuDS treatment	Total Treatment efficiencies (%) used for proposed mitigation / SuDS treatment		
			Copper	Zinc	Total Suspended Solids (TSS)
OU14	Ordinary Watercourse 28	Passive Treatment	0	0	0
OU13A	Ordinary Watercourse 28	Online Storage & Vegetated Ditch	15	15	25
OU15	River Ter	Online Storage	0	0	0
OU17	River Ter	Filter Drain (54.24%)	0	24	32
OU18	River Ter	Filter Drain (50%) & Attenuation Pond	40	45	72
OU19	Ordinary Watercourse 7	Cascading Attenuation Pond with two Basins	40	61	84
OU19C	Ordinary Watercourse 7	Attenuation Pond	40	30	60
OU19C1	Ordinary Watercourse 7	Attenuation Pond	40	30	60
OU23 (+ 23C, 23D, 24A)	Ordinary Watercourse 32	Filter Drain (17.96%) & Cascading Attenuation Pond with three Basins	80	70	95
OU23C	Ordinary Watercourse 32	Attenuation Pond	40	30	60
OU23D	Ordinary Watercourse 32	Filter Drain (12.93%) & Attenuation Pond	40	34	63

Outfall number	Receiving watercourse	Proposed mitigation / SuDS treatment	Total Treatment efficiencies (%) used for proposed mitigation / SuDS treatment		
			Copper	Zinc	Total Suspended Solids (TSS)
OU24A	Ordinary Watercourse 32	Vegetated Ditch (90%) & Attenuation Pond	48	39	69
OU24B	Ordinary Watercourse 32	Filter Drain (2.98%), Vegetated Ditch (75%), Attenuation Pond	46	38	68
Design section 2 (S2) of the proposed scheme, beyond A12 Junction 21 to beyond A12 Junction 23					
OU03	Ordinary Watercourse 9	Online Storage	0	0	0
OU04	River Brain	Attenuation Pond	40	30	60
OU05	River Brain	Online Storage	0	0	0
OU08	River Blackwater	Filter Drain (54%) & Online Storage	0	24	32
OU09	Ordinary Watercourse 10	Filter Drain (30%) & Cascading Attenuation Pond with two Basins	64	57	86
OU09A	Ordinary Watercourse 10	Filter Drain (53%) & Online Storage	0	23	31
OU10	Ordinary Watercourse 10	Filter Drain (20%) & Attenuation Pond & Vegetated ditch	49	45	73
OU11	Ordinary Watercourse 11	Attenuation Pond	40	30	60

Outfall number	Receiving watercourse	Proposed mitigation / SuDS treatment	Total Treatment efficiencies (%) used for proposed mitigation / SuDS treatment		
			Copper	Zinc	Total Suspended Solids (TSS)
OU14	Ordinary Watercourse 12a	Filter Drain (22%) & Attenuation Pond	40	36	65
OU15A	Ordinary Watercourse 12a	Filter Drain (11%) & Cascading Attenuation Pond with two Basins	64	53	84
OU15C	Ordinary Watercourse 13	Filter Drain (27%) & Cascading Attenuation Pond with two Basins	64	56	86
OU15C1	Ordinary Watercourse 15a	Filter Drain (18%) & Attenuation Pond	40	35	64
OU15D	Ordinary Watercourse 13	Attenuation Pond	40	30	60
OU15D1	River Blackwater	Passive Treatment	0	0	0
OU15E	Ordinary Watercourse 12a	Attenuation Pond	40	30	60
OU15G	Rivenhall Brook	Filter Drain (14%) & Attenuation Pond	40	34	63
OU15H	Ordinary Watercourse 17	Attenuation Pond	40	30	60
OU17	Existing Drainage	Passive Treatment	0	0	0
OU18	River Blackwater	Filter Drain (22%) & Attenuation Pond (70%), Passive Treatment (30%)	28	27	47

Outfall number	Receiving watercourse	Proposed mitigation / SuDS treatment	Total Treatment efficiencies (%) used for proposed mitigation / SuDS treatment		
			Copper	Zinc	Total Suspended Solids (TSS)
OU19	River Blackwater	Attenuation Pond	40	30	60
OU24	Rivenhall Brook	Filter Drain (58%) & Online Storage	0	26	34
OU24A	Rivenhall Brook	Filter Drain (13%) & Attenuation Pond	40	34	63
OU26	Ordinary Watercourse 17	Passive Treatment	0	0	0
OU27	River Blackwater	Online Storage	0	0	0
Design section 3 (S3) of the proposed scheme, beyond A12 Junction 23 up to A12 Junction 26					
OU01	River Blackwater	Filter Drain (24.14%) & Attenuation Pond	40	37	65
OU02	River Blackwater	Filter Drain (54.89%) & Cascading Attenuation Pond with two Basins	64	63	88
OU03	Ordinary Watercourse 18	Attenuation Pond	40	30	60
OU04	Ordinary Watercourse 21	Attenuation Pond	40	30	60
OU05	River Blackwater	Attenuation Pond	40	30	60
OU06	Ordinary Watercourse 21a	Filter Drain (100%)	0	45	60

Outfall number	Receiving watercourse	Proposed mitigation / SuDS treatment	Total Treatment efficiencies (%) used for proposed mitigation / SuDS treatment		
			Copper	Zinc	Total Suspended Solids (TSS)
OU07A	Ordinary Watercourse 21a	Filter Drain (100%)	0	45	60
OU08	Domsey Brook d/s	Attenuation Pond	40	30	60
OU08A	Domsey Brook d/s	Filter Drain (74.74%) & Attenuation Pond	40	53	77
OU08B&8D	Unnamed Ditch	Filter Drain (29.80%) & Attenuation Pond	40	39	67
OU08C	Existing Drainage (Inworth Rd)	Vegetated Ditch (47.06%) & Online Storage	7	7	11
OU08E	Existing Drainage (Inworth Rd)	Attenuation Pond	40	30	60
OU09	Domsey Brook d/s	Attenuation Pond	40	30	60
OU10	Domsey Brook d/s	Filter Drain (36.63%) & Attenuation Pond	40	41	68
OU13	Ordinary Watercourse 35	Attenuation Pond	40	30	60
OU14	Ordinary Watercourse 21a	Attenuation Pond	40	30	60
OU15	Ordinary Watercourse 26	Passive Treatment	0	0	0
OU15B	Ordinary Watercourse 26	Attenuation Pond	40	30	60

Outfall number	Receiving watercourse	Proposed mitigation / SuDS treatment	Total Treatment efficiencies (%) used for proposed mitigation / SuDS treatment		
			Copper	Zinc	Total Suspended Solids (TSS)
OU15C	Ordinary Watercourse 26	Attenuation Pond	40	30	60
OU16 & OU15A	Ordinary Watercourse 36	Filter Drain (32.98%) & Attenuation Pond	40	40	67
OU17	Roman River	Filter Drain (37.84%) & Attenuation Pond (90%)	36	38	63
OU18	Roman River	Online Storage	0	0	0
OU19	Domsey Brook d/s	Filter Drain (15.64%) & Attenuation Pond	40	34	63
OU20	Unnamed Ditch	Swale	50	50	80
OU21	Ordinary Watercourse 23	Cascading Attenuation Pond with two basins	64	51	84
OU22	Ordinary Watercourse 23	Attenuation Pond	40	30	60
OU23	Ordinary Watercourse 23	Attenuation Pond	40	30	60
OU24	Ordinary Watercourse 23	Filter Drain (23.44%) & Attenuation Pond	40	37	65
OU26	Ordinary Watercourse 37	Filter Drain (42.56%) & Attenuation Pond	40	43	70

Outfall number	Receiving watercourse	Proposed mitigation / SuDS treatment	Total Treatment efficiencies (%) used for proposed mitigation / SuDS treatment		
			Copper	Zinc	Total Suspended Solids (TSS)
OU26A	Ordinary Watercourse 37	Filter Drain (85.95%) & Cascading Attenuation Pond with two basins & Vegetated outfall	69	74	94
OU26B	Ordinary Watercourse 38	Attenuation Pond	40	30	60
OU27	Ordinary Watercourse 39	Attenuation Pond	40	30	60
OU27A	Ordinary Watercourse 40	Swale	50	50	80
OU28	Ordinary Watercourse 39	Swale	50	50	80
OU29	Unnamed Ditch	Attenuation Pond	40	30	60
OU30	Domsey Brook u/s	Filter Drain (57.34%) & Cascading Attenuation Pond with two basins	64	63	89
OU30A	Domsey Brook u/s	Filter Drain (54.82%) & Cascading Attenuation Pond with two basins & Vegetated outfall	69	68	91
OU31	Unnamed Ditch	Attenuation Pond	40	30	60
OU32	Ordinary Watercourse 41	Attenuation Pond	40	30	60
OU33	Ordinary Watercourse 42	Attenuation Pond	40	30	60

Outfall number	Receiving watercourse	Proposed mitigation / SuDS treatment	Total Treatment efficiencies (%) used for proposed mitigation / SuDS treatment		
			Copper	Zinc	Total Suspended Solids (TSS)
Inworth Road (IWR) of the proposed scheme, adjacent to J24					
IWR1	Existing Inworth Rd drainage but suspected to ultimately be Ordinary Watercourse 34	Ditch (No Treatment)	0	0	0
IWR2	Ordinary Watercourse 34	Attenuation Pond	40	30	60
IWR3	Ordinary Watercourse 34	Attenuation Pond	40	30	60
IWR4	Ordinary Watercourse 34	Ditch (No Treatment)	0	0	0
IWR5	Ordinary Watercourse 34C	Attenuation Pond	40	30	60
IWR6	Ordinary Watercourse 34C	Ditch (No Treatment)	0	0	0
IWR7	Ordinary Watercourse 34C	Attenuation Pond	40	30	60

E.1.2 Table E.2 presents the proposed mitigation/SuDS treatment trains associated cumulative assessments for the proposed scheme. Where applicable the treatment efficiencies for cumulative assessments have been calculated using a catchment (area) weighted approach which is described fully in Annex A. The outfall numbers are listed from upstream to downstream (for example, OU07, OU7A is OU07 flowing downstream to OU07A) and the proposed mitigation is listed is corresponding order to the outfalls (for example for OU07, OU7A, No attenuation corresponds to OU07 and Filter Drain & Attenuation Pond corresponds to OU07A).

Table E.2 Proposed mitigation / SuDS treatment trains for cumulative assessments

Outfall numbers	Receiving watercourse	Proposed mitigation / SuDS treatment	Total Treatment efficiencies (%) used for proposed mitigation / SuDS treatment		
			Copper	Zinc	Total Suspended Solids (TSS)
Design section 1 (S1) of the proposed scheme, beyond A12 Junction 18 to beyond A12 Junction 21					
OU07, OU7A	Ordinary Watercourse 2	Passive treatment, Filter Drain and Attenuation Pond	14	13	23
OU12, OU10, OU10A, OU11	Boreham Brook	Filter Drains, Passive Treatment, Attenuation Pond	33	33	57
OU14, OU13A	Ordinary Watercourse 28	Passive treatment and Vegetated Ditch	4	4	7
OU17 & OU18, OU15, OU13	River Ter	Filter Drains, Passive Treatment, Attenuation Pond	21	32	50
OU19C, OU19C1	Ordinary Watercourse 7	Attenuation Ponds	40	30	60
OU19C, OU19C1, OU19	Ordinary Watercourse 7	Double Attenuation Pond and Attenuation Ponds	53	42	73

Outfall numbers	Receiving watercourse	Proposed mitigation / SuDS treatment	Total Treatment efficiencies (%) used for proposed mitigation / SuDS treatment		
			Copper	Zinc	Total Suspended Solids (TSS)
Design section 2 (S2) of the proposed scheme, beyond A12 Junction 21 to beyond A12 Junction 23					
OU04 & OU05	River Brain	Attenuation Pond and Online Storage	24	18	36
OU9 & OU10	Ordinary Watercourse 10	Filter Drains, Attenuation Pond, Vegetated Ditch	59	54	83
OU9, OU9A, OU10	Ordinary Watercourse 10	Filter Drains, Online Storage, Attenuation Pond, Vegetated Ditch	55	52	79
OU15A & OU14	Ordinary Watercourse 12	Filter Drains & Attenuation Ponds	58	49	80
OU15A, OU14, OU15E	Ordinary Watercourse 12	Filter Drains & Attenuation Ponds	56	47	78
OU15C & OU15D	Ordinary Watercourse 13	Filter Drains & Attenuation Ponds	62	54	84
OU24 & OU24A	Rivenhall Brook	Filter Drains, Passive Treatment, Attenuation Pond	20	30	49
OU24, OU24A, OU15G	Rivenhall Brook	Filter Drains, Passive Treatment, Attenuation Pond	36	33	60
OU18 + OU27 + OU19	River Blackwater	Filter Drain, Retention Ponds and Passive Treatment	33	26	51
OU15H & OU26	Ordinary Watercourse 17	Attenuation Pond and Online Storage	22	16	33

Outfall numbers	Receiving watercourse	Proposed mitigation / SuDS treatment	Total Treatment efficiencies (%) used for proposed mitigation / SuDS treatment		
			Copper	Zinc	Total Suspended Solids (TSS)
Design section 3 (S3) of the proposed scheme, beyond A12 Junction 23 up to A12 Junction 26					
OU01 & OU05	River Blackwater	Filter Drains & Attenuation Pond	40	36	65
(OU02, OU05, OU01) + (S2 - OU18 & OU19)	River Blackwater	Filter Drains, Passive Treatment, Attenuation Pond	49	44	71
OU06 & OU7A	Ordinary Watercourse 21a	Filter Drain	0	45	60
OU14, OU06 & OU7A	Ordinary Watercourse 21a	Filter Drains & Attenuation Pond	11	43	60
OU08, OU19, OU09, OU10	Domsey Brook d/s	Filter Drains & Attenuation Ponds	40	33	62
OU08A, OU08, OU19, OU09	Domsey Brook d/s	Filter Drains & Attenuation Ponds	40	34	63
OU8C & OU8E	Existing Drainage (Inworth Rd ultimately Domsey Brook)	Vegetated Ditch, Online Storage & Attenuation Pond	30	23	45
OU15, OU15B, OU15C	Ordinary Watercourse 26	Passive Treatment & Attenuation Ponds	15	11	23
OU17 & OU18	Roman River	Filter Drains, Online Storage & Attenuation Pond	29	31	50

Outfall numbers	Receiving watercourse	Proposed mitigation / SuDS treatment	Total Treatment efficiencies (%) used for proposed mitigation / SuDS treatment		
			Copper	Zinc	Total Suspended Solids (TSS)
OU21, OU22, OU23 & OU24	Ordinary Watercourse 23	Filter Drains & Attenuation Ponds	52	40	70
OU26, OU26A	Ordinary Watercourse 37	Filter Drains, Attenuation Ponds & Vegetated outfall	60	65	87
OU27, & OU28	Ordinary Watercourse 39	Swale and Attenuation Ponds	43	37	67
OU30A, OU30	Domsey Brook u/s	Filter Drains, Attenuation Ponds & Vegetated outfall	66	66	90
Inworth Road (IWR) of the proposed scheme, adjacent to J24					
IWR1 to IWR7	Ordinary Watercourse 34	Passive treatment & Attenuation Pond	24	18	36

Annex F Residual significance of effects

F.1.1 All spillage risk assessments undertaken and presented in Section 6 of this appendix have returned a 'Pass' result, therefore spillage risk has not influenced the overall residual effect of routine runoff results.

F.1.2 Table F.1 presents the outfalls and their overall residual significance of effect, after mitigation, for all single outfall HEWRAT routine runoff assessments. The mitigation included at this stage has been based upon the proposed drainage design. The value of the receiving watercourse receptor is detailed in the Environmental Statement (Chapter 14: Road drainage and the water environment [TR010060/APP/6.1]). Where the value of the receiving watercourse and the magnitude of impact result in an option of two residual significance of effect values, evidence is required to support the choice of one significance of effect value.

F.1.3 The following approach has been applied when determining the residual significance of effect:

- For Low or Medium value receptors assigned a Negligible magnitude of impact, a Neutral significance of effect has been selected over Slight, where all aspects of HEWRAT pass.
- For Low value receptors assigned a Minor magnitude of impact, a Slight significance of effect has been selected over Neutral, as a failed result has been recorded for at least one aspect of the HEWRAT (routine runoff) assessment.
- For High value receptors assigned a Minor magnitude of impact, the choices of significance of effect are Slight/Moderate. If a HEWRAT assessment records RST6 failures for either copper or zinc, the higher (i.e. worse) of the two options has been selected. If only the RST24 fails, the lower of the two options has been selected. If the sediment bound pollutants fail and are the cause of the Minor magnitude of impact (RSTs for copper and zinc pass in this scenario), the higher of the two options has been selected.

F.1.4 In accordance with DMRB LA 113 all rivers, within the proposed scheme study area, with a WFD/WER designated status have been assigned a High value. All minor watercourses and unnamed ditches that have no WFD/WER designation have been assigned a Medium or Low value. A low value has been selected when Q95 flows in the watercourse are below 0.001m^3/s which typically represents an ephemeral watercourse, this has been based upon organisational judgement as well as desk based sources (I.e. OS mapping) as described in the Environmental Statement.

F.1.5 As discussed in Section 3 of this appendix, for low flow watercourses the magnitude of impact and significance of effect has been based upon the groundwater assessment results. These have been distinguished in Table F.1 and Table F.2 from where the surface water results have been used.

Table F.1 Residual significance of effects of routine runoff single outfall assessments

Design section number (S1, S2, S3 or IWR)	Outfall Number	Receiving watercourse	Value of the receiving watercourse receptor	Magnitude and effect based upon Surface water (SW) or groundwater (GW) assessment	Magnitude of Impact with mitigation	Residual Significance of Effect
S1	OU01	River Chelmer	High	SW	Negligible	Slight
S1	OU07	Ordinary Watercourse 2	Low	GW	Negligible	Neutral
S1	OU07A	Ordinary Watercourse 2	Low	GW	Negligible	Neutral
S1	OU10	Boreham Brook	High	SW	Negligible	Slight
S1	OU10A	Boreham Brook	High	SW	Negligible	Slight
S1	OU11	Boreham Brook	High	SW	Negligible	Slight
S1	OU12	Boreham Brook	High	SW	Negligible	Slight
S1	OU13	River Ter	High	SW	Negligible	Slight
S1	OU13A	Ordinary Watercourse 28	Low	GW	Negligible	Neutral
S1	OU14	Ordinary Watercourse 28	Low	GW	Negligible	Neutral
S1	OU15	River Ter	High	SW	Negligible	Slight
S1	OU17	River Blackwater	High	SW	Negligible	Slight

Design section number (S1, S2, S3 or IWR)	Outfall Number	Receiving watercourse	Value of the receiving watercourse receptor	Magnitude and effect based upon Surface water (SW) or groundwater (GW) assessment	Magnitude of Impact with mitigation	Residual Significance of Effect
S1	OU18	River Blackwater	High	SW	Negligible	Slight
S1	OU19	Ordinary Watercourse 7	Low	GW	Negligible	Neutral
S1	OU19C	Ordinary Watercourse 7	Low	GW	Negligible	Neutral
S1	OU19C1	Ordinary Watercourse 7	Low	GW	Negligible	Neutral
S1	OU23	Ordinary Watercourse 32	Low	GW	Negligible	Neutral
S1	OU23C	Ordinary Watercourse 32	Low	GW	Negligible	Neutral
S1	OU23D	Ordinary Watercourse 32	Low	GW	Negligible	Neutral
S1	OU24A	Ordinary Watercourse 32	Low	GW	Negligible	Neutral
S1	OU24B	Ordinary Watercourse 32	Low	GW	Negligible	Neutral
S2	OU03	Ordinary Watercourse 9	Low	GW	Negligible	Neutral

Design section number (S1, S2, S3 or IWR)	Outfall Number	Receiving watercourse	Value of the receiving watercourse receptor	Magnitude and effect based upon Surface water (SW) or groundwater (GW) assessment	Magnitude of Impact with mitigation	Residual Significance of Effect
S2	OU04	River Brain	High	SW	Negligible	Slight
S2	OU05	River Brain	High	SW	Negligible	Slight
S2	OU08	River Blackwater	High	SW	Negligible	Slight
S2	OU09	Ordinary Watercourse 10	Low	GW	Negligible	Neutral
S2	OU09A	Ordinary Watercourse 10	Low	GW	Negligible	Neutral
S2	OU10	Ordinary Watercourse 10	Low	GW	Negligible	Neutral
S2	OU11	Ordinary Watercourse 11	Low	GW	Negligible	Neutral
S2	OU14	Ordinary Watercourse 12a	Low	GW	Negligible	Neutral
S2	OU15A	Ordinary Watercourse 12a	Low	GW	Negligible	Neutral
S2	OU15C	Ordinary Watercourse 13	Low	GW	Negligible	Neutral
S2	OU15C1	Ordinary Watercourse 15a	Low	GW	Negligible	Neutral

Design section number (S1, S2, S3 or IWR)	Outfall Number	Receiving watercourse	Value of the receiving watercourse receptor	Magnitude and effect based upon Surface water (SW) or groundwater (GW) assessment	Magnitude of Impact with mitigation	Residual Significance of Effect
S2	OU15D	Ordinary Watercourse 13	Low	GW	Negligible	Neutral
S2	OU15D1	River Blackwater	High	SW	Negligible	Slight
S2	OU15E	Ordinary Watercourse 12a	Low	GW	Negligible	Neutral
S2	OU15G	Rivenhall Brook	Medium	SW	Negligible	Neutral
S2	OU15H	Ordinary Watercourse 17	Low	SW	Negligible	Neutral
S2	OU17	Existing Drainage	Low	SW	Negligible	Neutral
S2	OU18	River Blackwater	High	SW	Negligible	Slight
S2	OU19	River Blackwater	High	SW	Negligible	Slight
S2	OU24	Rivenhall Brook	Medium	SW	Negligible	Neutral
S2	OU24A	Rivenhall Brook	Medium	SW	Negligible	Neutral
S2	OU26	Ordinary Watercourse 17	Low	GW	Negligible	Neutral
S2	OU27	River Blackwater	High	SW	Negligible	Slight
S3	OU01	River Blackwater	High	SW	Negligible	Slight

Design section number (S1, S2, S3 or IWR)	Outfall Number	Receiving watercourse	Value of the receiving watercourse receptor	Magnitude and effect based upon Surface water (SW) or groundwater (GW) assessment	Magnitude of Impact with mitigation	Residual Significance of Effect
S3	OU02	River Blackwater	High	SW	Negligible	Slight
S3	OU03	Ordinary Watercourse 18	Low	GW	Negligible	Neutral
S3	OU04	Ordinary Watercourse 21	Low	GW	Negligible	Neutral
S3	OU05	River Blackwater	High	SW	Negligible	Slight
S3	OU06	Ordinary Watercourse 21a	Low	GW	Negligible	Neutral
S3	OU07A	Ordinary Watercourse 21a	Low	GW	Negligible	Neutral
S3	OU08	Domsey Brook d/s	High	SW	Negligible	Slight
S3	OU08A	Domsey Brook d/s	High	SW	Negligible	Slight
S3	OU08B&8D	Unnamed Ditch	Low	GW	Negligible	Neutral
S3	OU08C	Existing Drainage (Inworth Road, ultimately Domsey Brook d/s)	Low	GW	Negligible	Neutral
S3	OU08E	Existing Drainage (Inworth Road,	Low	GW	Negligible	Neutral

Design section number (S1, S2, S3 or IWR)	Outfall Number	Receiving watercourse	Value of the receiving watercourse receptor	Magnitude and effect based upon Surface water (SW) or groundwater (GW) assessment	Magnitude of Impact with mitigation	Residual Significance of Effect
		ultimately Domsey Brook d/s)				
S3	OU09	Domsey Brook d/s	High	SW	Negligible	Slight
S3	OU10	Domsey Brook d/s	High	SW	Negligible	Slight
S3	OU13	Ordinary Watercourse 35	Low	GW	Negligible	Neutral
S3	OU14	Ordinary Watercourse 21a	Low	GW	Negligible	Neutral
S3	OU15	Ordinary Watercourse 26	Low	GW	Negligible	Neutral
S3	OU15A & 16	Ordinary Watercourse 36	Low	GW	Negligible	Neutral
S3	OU15B	Ordinary Watercourse 26	Low	GW	Negligible	Neutral
S3	OU15C	Ordinary Watercourse 26	Low	GW	Minor	Neutral
S3	OU17	Roman River	High	SW	Negligible	Slight
S3	OU18	Roman River	High	SW	Negligible	Slight
S3	OU19	Domsey Brook d/s	High	SW	Negligible	Slight

Design section number (S1, S2, S3 or IWR)	Outfall Number	Receiving watercourse	Value of the receiving watercourse receptor	Magnitude and effect based upon Surface water (SW) or groundwater (GW) assessment	Magnitude of Impact with mitigation	Residual Significance of Effect
S3	OU20	Domsey Brook d/s	Low	GW	Negligible	Neutral
S3	OU21	Ordinary Watercourse 23	Low	GW	Negligible	Neutral
S3	OU22	Ordinary Watercourse 23	Low	GW	Negligible	Neutral
S3	OU23	Ordinary Watercourse 23	Low	GW	Negligible	Neutral
S3	OU24	Ordinary Watercourse 23	Low	GW	Negligible	Neutral
S3	OU26	Ordinary Watercourse 37	Low	GW	Minor	Neutral
S3	OU26A	Ordinary Watercourse 37	Low	GW	Negligible	Neutral
S3	OU26B	Ordinary Watercourse 38	Low	SW	Negligible	Neutral
S3	OU27	Ordinary Watercourse 39	Low	GW	Negligible	Neutral
S3	OU27A	Ordinary Watercourse 40	Low	GW	Negligible	Neutral

Design section number (S1, S2, S3 or IWR)	Outfall Number	Receiving watercourse	Value of the receiving watercourse receptor	Magnitude and effect based upon Surface water (SW) or groundwater (GW) assessment	Magnitude of Impact with mitigation	Residual Significance of Effect
S3	OU28	Ordinary Watercourse 39	Low	GW	Negligible	Neutral
S3	OU29	Unnamed Ditch	Low	GW	Negligible	Neutral
S3	OU30	Domsey Brook u/s	High	SW	Negligible	Slight
S3	OU30A	Domsey Brook u/s	High	SW	Negligible	Slight
S3	OU31	Unnamed Ditch	Low	GW	Negligible	Neutral
S3	OU32	Ordinary Watercourse 41	Low	GW	Negligible	Neutral
S3	OU33	Ordinary Watercourse 42	Low	GW	Negligible	Neutral
IWR	IWR1	Existing Inworth Rd drainage but suspected to ultimately be Ordinary Watercourse 34	Low	GW	Negligible	Neutral
IWR	IWR2	Ordinary Watercourse 34	Low	GW	Negligible	Neutral
IWR	IWR3	Ordinary Watercourse 34	Low	GW	Negligible	Neutral

Design section number (S1, S2, S3 or IWR)	Outfall Number	Receiving watercourse	Value of the receiving watercourse receptor	Magnitude and effect based upon Surface water (SW) or groundwater (GW) assessment	Magnitude of Impact with mitigation	Residual Significance of Effect
IWR	IWR4	Ordinary Watercourse 34	Low	GW	Negligible	Neutral
IWR	IWR5	Ordinary Watercourse 34C	Low	GW	Negligible	Neutral
IWR	IWR6	Ordinary Watercourse 34C	Low	GW	Negligible	Neutral
IWR	IWR7	Ordinary Watercourse 34C	Low	GW	Negligible	Neutral

F.1.6 Table F.2 presents outfalls and their overall residual significance of effect, after mitigation, for all cumulative routine runoff assessments.

Table F.2 Residual significance of effects of routine runoff cumulative assessments

Design section number	Outfall Number	Outfalls draining to assessment outfall	Receiving watercourse	Assessment type	Value of the receiving watercourse receptor	Magnitude and effect based upon Surface water (SW) or groundwater (GW)	Magnitude of Impact with mitigation	Residual Significance of Effect
S1	OU07A	OU07, OU7A	Ordinary Watercourse 2	100m-1km	Low	GW	Minor	Neutral
S1	OU11	OU12, OU10, OU10A, OU11	Boreham Brook	<100m	High	SW	Negligible	Slight
S1	OU13A	OU14, OU13A	Ordinary Watercourse 28	100m-1km	Low	GW	Minor	Neutral
S1	OU13	OU17 & OU18, OU15, OU13	River Ter	100m-1km	High	SW	Negligible	Slight
S1	OU19C1	OU19C, OU19C1	Ordinary Watercourse 7	<100m	Low	GW	Negligible	Neutral
S1	OU19	OU19C, OU19C1, OU19	Ordinary Watercourse 7	100m-1km	Low	GW	Minor	Neutral
S2	OU04	OU04 & OU05	River Brain	<100m	High	SW	Negligible	Slight

Design section number	Outfall Number	Outfalls draining to assessment outfall	Receiving watercourse	Assessment type	Value of the receiving watercourse receptor	Magnitude and effect based upon Surface water (SW) or groundwater (GW)	Magnitude of Impact with mitigation	Residual Significance of Effect
S2	OU10	OU9 + OU10	Ordinary Watercourse 10	<100m	Low	GW	Minor	Neutral
S2	OU10	OU9, 0U9A + OU10	Ordinary Watercourse 10	100m-1km	Low	GW	Minor	Neutral
S2	OU14	OU15A + OU14	Ordinary Watercourse 12	<100m	Low	GW	Minor	Neutral
S2	OU15E	OU15A + OU14 + OU15E	Ordinary Watercourse 12	100m-1km	Low	GW	Minor	Neutral
S2	OU15C	OU15C + OU15D	Ordinary Watercourse 13	<100m	Low	GW	Minor	Neutral
S2	OU24A	OU24 + OU24A	Rivenhall Brook	<100m	Medium	SW	Negligible	Neutral
S2	OU15G	OU24 + OU24A + OU15G	Rivenhall Brook	100m-1km	Medium	SW	Negligible	Neutral
S2	OU19	OU18 + OU27 + OU19	River Blackwater	100m-1km	High	SW	Negligible	Slight

Design section number	Outfall Number	Outfalls draining to assessment outfall	Receiving watercourse	Assessment type	Value of the receiving watercourse receptor	Magnitude and effect based upon Surface water (SW) or groundwater (GW)	Magnitude of Impact with mitigation	Residual Significance of Effect
S2	OU26	OU15H + OU26	Ordinary Watercourse 17	100m-1km	Low	GW	Minor	Neutral
S3	OU01	OU01 & OU05	River Blackwater	<100m	High	SW	Negligible	Slight
S3	S2 - OU19	(OU02, OU05, OU01) + (S2 - OU18 & OU19)	River Blackwater	100m-1km	High	SW	Negligible	Slight
S3	OU06	OU06 & OU7A	Ordinary Watercourse 21a	<100m	Low	GW	Negligible	Neutral
S3	OU14	OU14, OU06 & OU7A	Ordinary Watercourse 21a	100m-1km	Low	GW	Negligible	Neutral
S3	OU08	OU08, OU19, OU09, OU10	Domsey Brook d/s	100m-1km	High	SW	Negligible	Slight
S3	OU08A	OU08A, OU08, OU19, OU09	Domsey Brook d/s	100m-1km	High	SW	Negligible	Slight
S3	OU8E	S3 -OU8C & OU8E	Existing Drainage (Inworth Rd	<100m	Low	GW	Negligible	Neutral

Design section number	Outfall Number	Outfalls draining to assessment outfall	Receiving watercourse	Assessment type	Value of the receiving watercourse receptor	Magnitude and effect based upon Surface water (SW) or groundwater (GW)	Magnitude of Impact with mitigation	Residual Significance of Effect
			ultimately Domsey Brook)					
S3	OU15	OU15, OU15B, OU15C	Ordinary Watercourse 26	100m-1km	Low	GW	Minor	Neutral
S3	OU18	OU17 & OU18	Roman River	100m-1km	High	SW	Minor	Slight
S3	OU22	OU21, OU22, OU23 & OU24	Ordinary Watercourse 23	100m-1km	Low	GW	Minor	Neutral
S3	OU26	OU26, OU26A	Ordinary Watercourse 37	100m-1km	Low	GW	Minor	Neutral
S3	OU28	OU27, & OU28	Ordinary Watercourse 39	100m-1km	Low	GW	Negligible	Neutral
S3	OU30	OU30A, OU30	Domsey Brook u/s	100m-1km	High	SW	Negligible	Slight

Design section number	Outfall Number	Outfalls draining to assessment outfall	Receiving watercourse	Assessment type	Value of the receiving watercourse receptor	Magnitude and effect based upon Surface water (SW) or groundwater (GW)	Magnitude of Impact with mitigation	Residual Significance of Effect
IWR	IWR2	IWR1 to IWR7	Ordinary Watercourse 34	100-1km	Low	GW	Negligible	Neutral

Annex G Figures

G.1.1 Figure 14.1.1 shows watercourse locations where Q95 values were calculated (i.e. low flow hydrology data received from HR Wallingford analysis) or derived (i.e. estimated using proportional scaling based on received HR Wallingford data or worst-case low flow scenario accepted in HEWRAT of $0.0011m^3/s$) for use in HEWRAT routine runoff assessments.

G.1.2 Figure 14.1.2 (single outfall assessment results) shows all proposed outfalls and colour codes them to match up with their overall residual significance effect (i.e. after Step 3 post mitigation) (Neutral = Green, Slight = Yellow, Moderate = Orange, Large / Very Large = Red) as detailed in Annex F.

G.1.3 Figure 14.1.3 (cumulative outfall assessment results) shows all proposed outfalls and colour codes them to match up with their overall residual significance effect (i.e. after Step 3 post mitigation) (Neutral = Green, Slight = Yellow, Moderate = Orange, Large / Very Large = Red) as detailed in Annex F.

G.1.4 Figure 14.1.4 shows the proposed drainage design catchment boundaries in different shades of colour. This figure can be used to differentiate the extent of catchment areas assessed as part of spillage risk assessment.

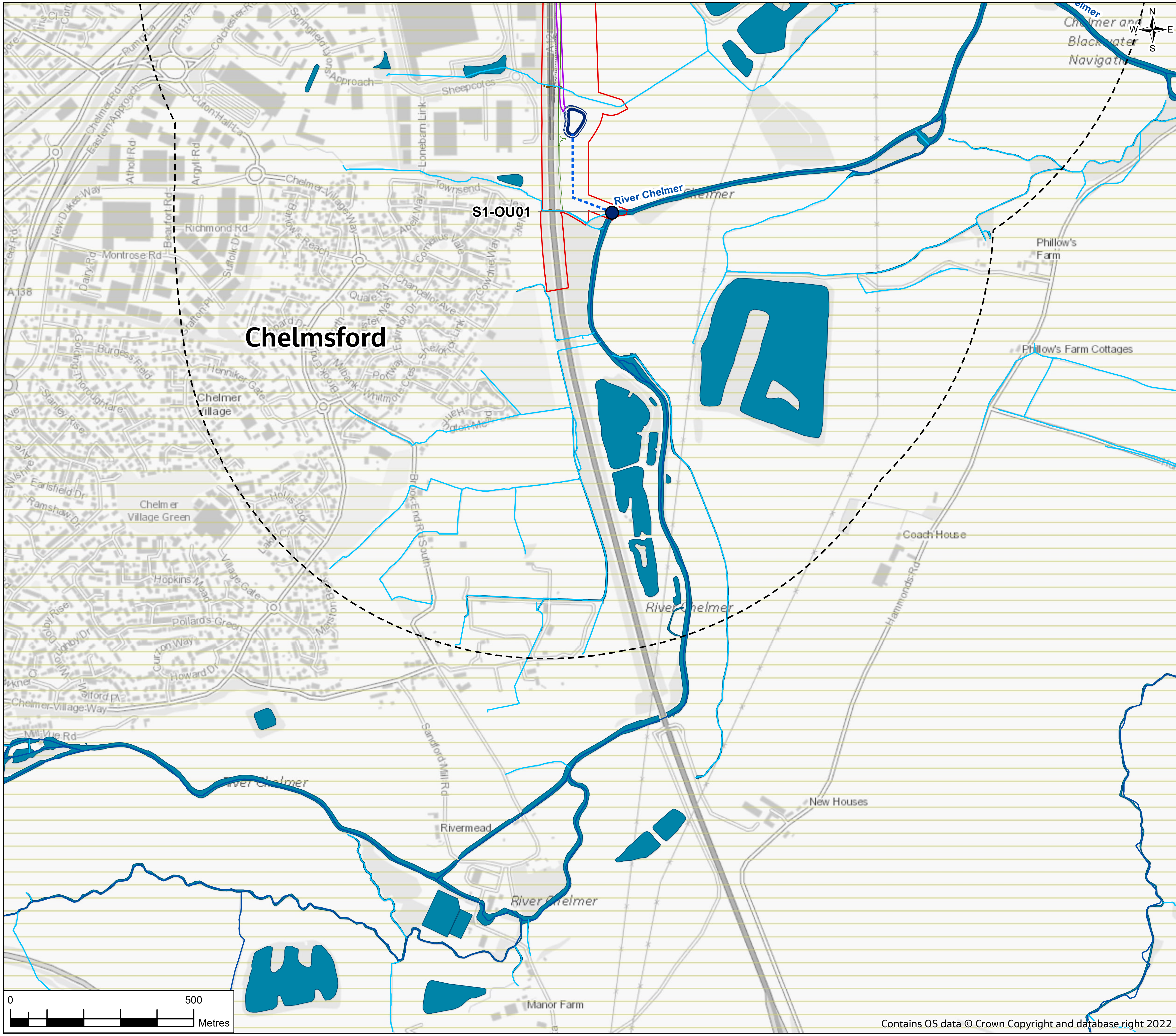


FIGURE 14.1.1

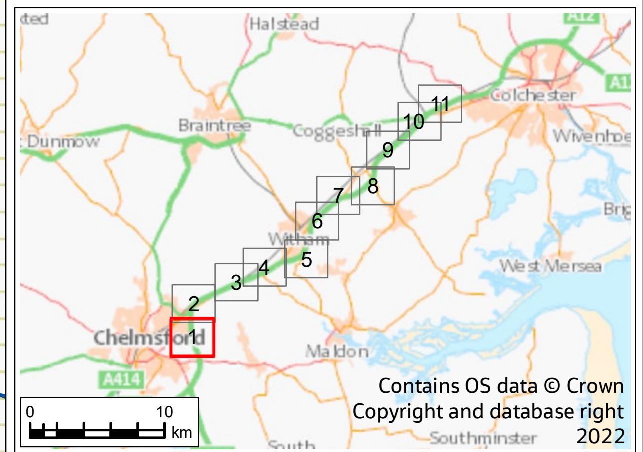
Legend

Proposed scheme
- Order Limits
- Study area
- Scheme
- Scheme culverts
- Cut-off ditch
- Temporary roads
- Private means of access and pond access tracks
- Haul roads
- River diversion
- Borrow pits
- Compounds and laydown areas
- Drainage pond
- Flood mitigation area

Low flow hydrology

Annual Q95 river flow m^3 / s
- ≤0.0011
- 0.0011 - 0.0100
- 0.0100 - 0.1000
- ≥0.1000

Water environment
- Main River
- Ordinary Watercourse
- Connection between proposed drainage pond and watercourse
- Existing water features (river, ponds, lakes and reservoirs)
- Drinking Water Safeguard Zone (surface water)



Rev.	Rev. Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd
P01	04/08/22	For DCO application	SSz	CW	DS	SG

Development Consent Order Drawing Number: TR010060/APP/6.3

APFP Regulation: Regulation 5(2)(a)

Client

national highways

Project

REGIONAL DELIVERY PARTNERSHIP
A12 CHELMSFORD TO A120 WIDENING SCHEME

Drawing Title

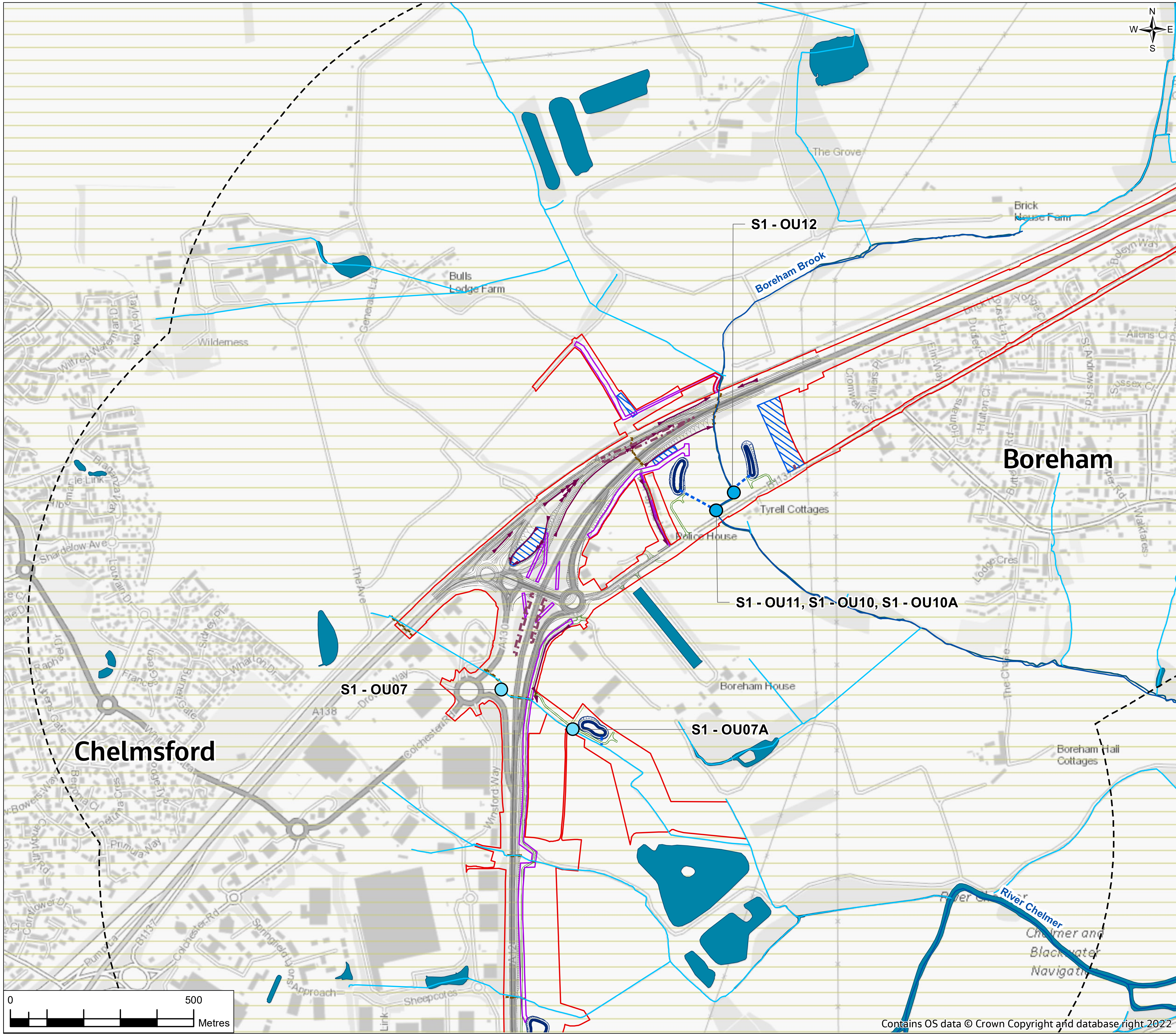
WATER QUALITY ASSESSMENT REPORT
LOW FLOW HYDROLOGY
SHEET 1 OF 11

Drawing Status: S4 - SUITABLE FOR STAGE APPROVAL

Scale @ A3	1:10000	DO NOT SCALE
Jacobs No.	B36601D1	
Client No.	HE551497	Rev P01

Drawing Number: HE551497-JAC-LDC-SCHW-SK-GI-0366

FIGURE 14.1.1



Legend

Proposed scheme

- Order Limits
- Study area
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- Scheme culverts
- Cut-off ditch
- Temporary roads
- Private means of access and pond access tracks
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- River diversion
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- Flood mitigation area

Low flow hydrology

Annual Q95 river flow m^3 / s

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Water environment

- Main River
- Ordinary Watercourse
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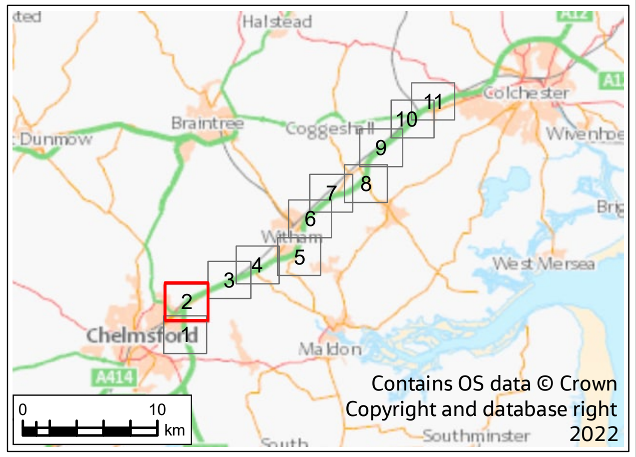
- Drinking Water Safeguard Zone (surface water)



P01	04/08/22	For DCO application	SSz	CW	DS	SG
Rev.	Rev. Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd

Development Consent Order Drawing Number: TR010060/APP/6.3

APFP Regulation: Regulation 5(2)(a)

Client: national highways

Project: REGIONAL DELIVERY PARTNERSHIP
A12 CHELMSFORD TO A120 WIDENING SCHEME

Drawing Title: WATER QUALITY ASSESSMENT REPORT
LOW FLOW HYDROLOGY
SHEET 2 OF 11

Drawing Status: S4 - SUITABLE FOR STAGE APPROVAL

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Client No.	HE551497	Rev P01

Drawing Number: HE551497-JAC-LDC-SCHW-SK-GI-0367

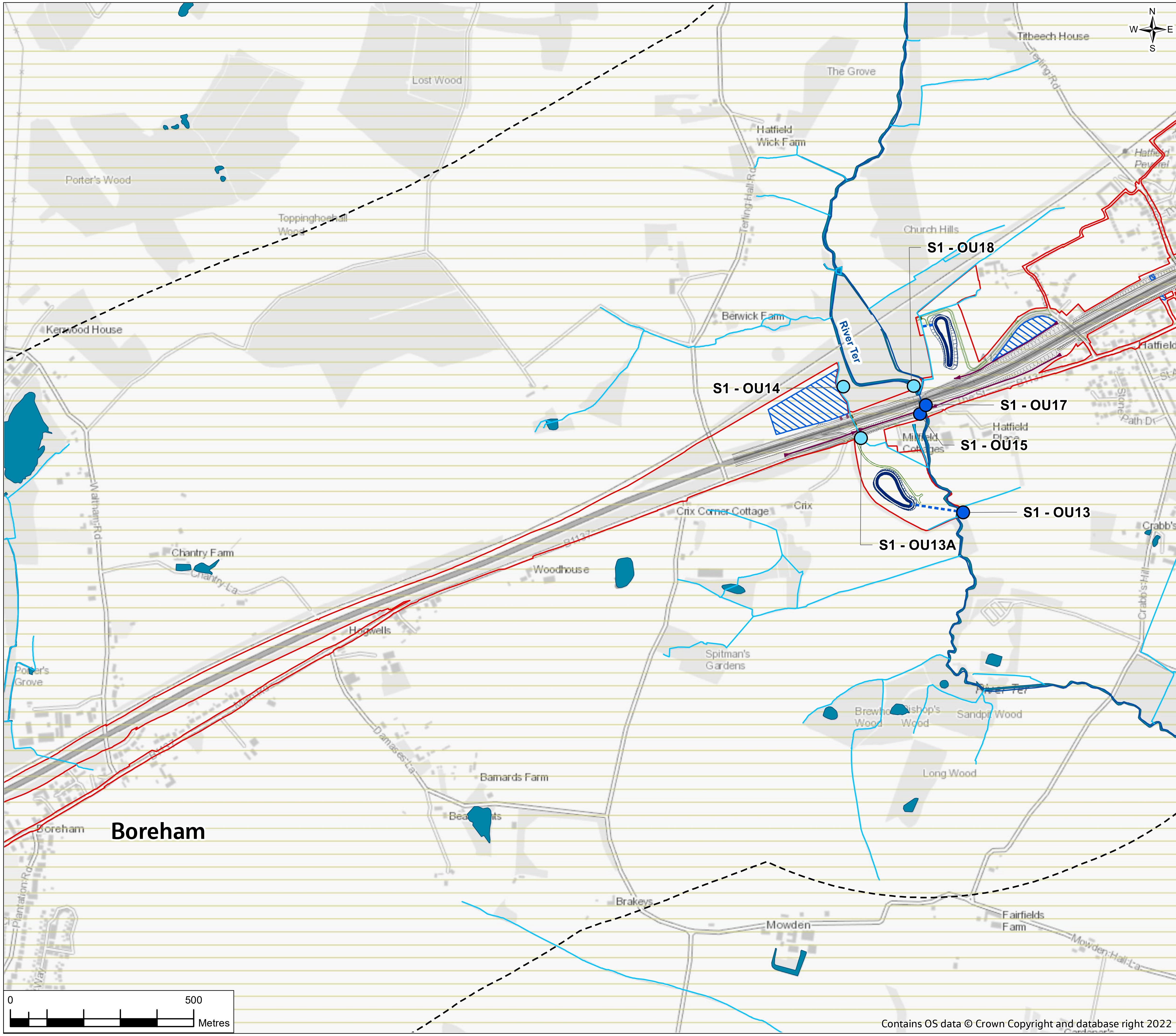

FIGURE 14.1.1

Legend

Proposed scheme

- Order Limits
- Study area
- Scheme
- Scheme culverts
- Cut-off ditch
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- Flood mitigation area

Low flow hydrology

Annual Q95 river flow m^3 / s

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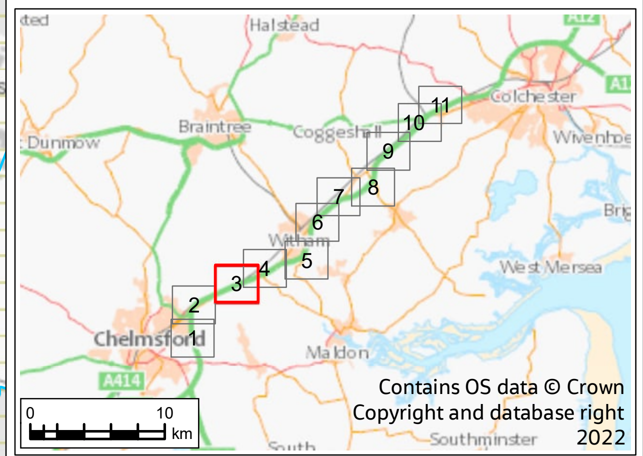
Water environment

- Main River
- Ordinary Watercourse
- Connection between proposed drainage pond and watercourse
- Existing water features (river, ponds, lakes and reservoirs)
- Drinking Water Safeguard Zone (surface water)



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P01	04/08/22	For DCO application	SSz	CW	DS	SG

Development Consent Order Drawing Number: TR010060/APP/6.3

APFP Regulation: Regulation 5(2)(a)

Client: national highways

Project: REGIONAL DELIVERY PARTNERSHIP
A12 CHELMSFORD TO A120 WIDENING SCHEME

Drawing Title: WATER QUALITY ASSESSMENT REPORT
LOW FLOW HYDROLOGY
SHEET 3 OF 11

Drawing Status: S4 - SUITABLE FOR STAGE APPROVAL

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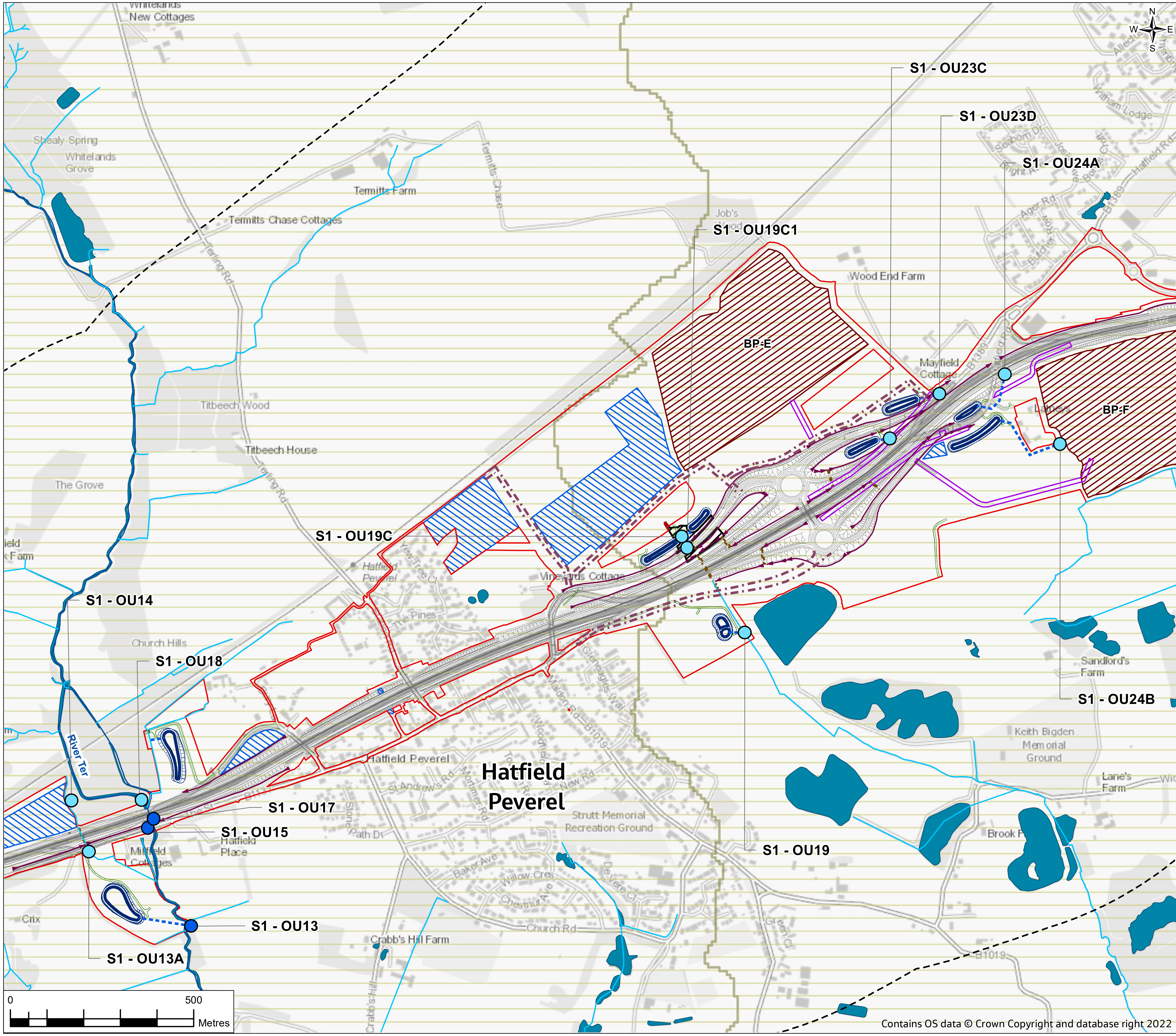
Client No.	HE551497	Rev P01

Drawing Number: HE551497-JAC-LDC-SCHW-SK-GI-0368

FIGURE 14.1.1



Legend

Proposed scheme

- Order Limits
- Study area
- Scheme
- Scheme culverts
- Cut-off ditch
- Temporary roads
- Private means of access and pond access tracks
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- River diversion
- Borrow pits
- Compounds and laydown areas
- Drainage pond
- Flood mitigation area

Low flow hydrology

Annual Q95 river flow m^3 / s

- ≤0.0011
- 0.0011 - 0.0100
- 0.0100 - 0.1000
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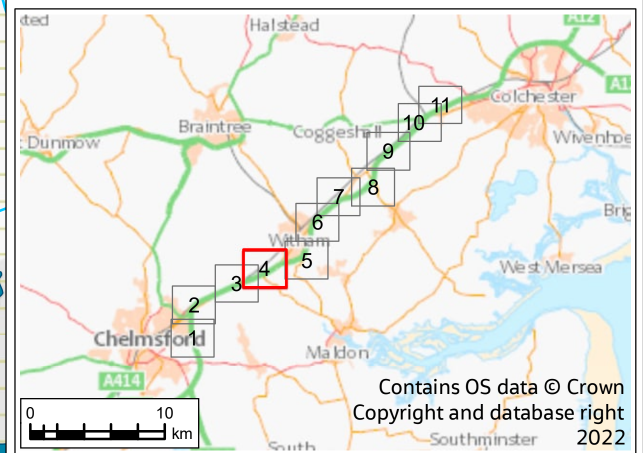
Water environment

- Main River
- Ordinary Watercourse
- Connection between proposed drainage pond and watercourse
- Existing water features (river, ponds, lakes and reservoirs)
- Drinking Water Safeguard Zone (surface water)



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Development Consent Order Drawing Number: TR010060/APP/6.3

APFP Regulation: Regulation 5(2)(a)

Client: national highways

Project: REGIONAL DELIVERY PARTNERSHIP A12 CHELMSFORD TO A120 WIDENING SCHEME

Drawing Title: WATER QUALITY ASSESSMENT REPORT LOW FLOW HYDROLOGY SHEET 4 OF 11

Drawing Status: S4 - SUITABLE FOR STAGE APPROVAL

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Client No.	HE551497
Rev	P01

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Drawing Number: HE551497-JAC-LDC-SCHW-SK-GI-0369

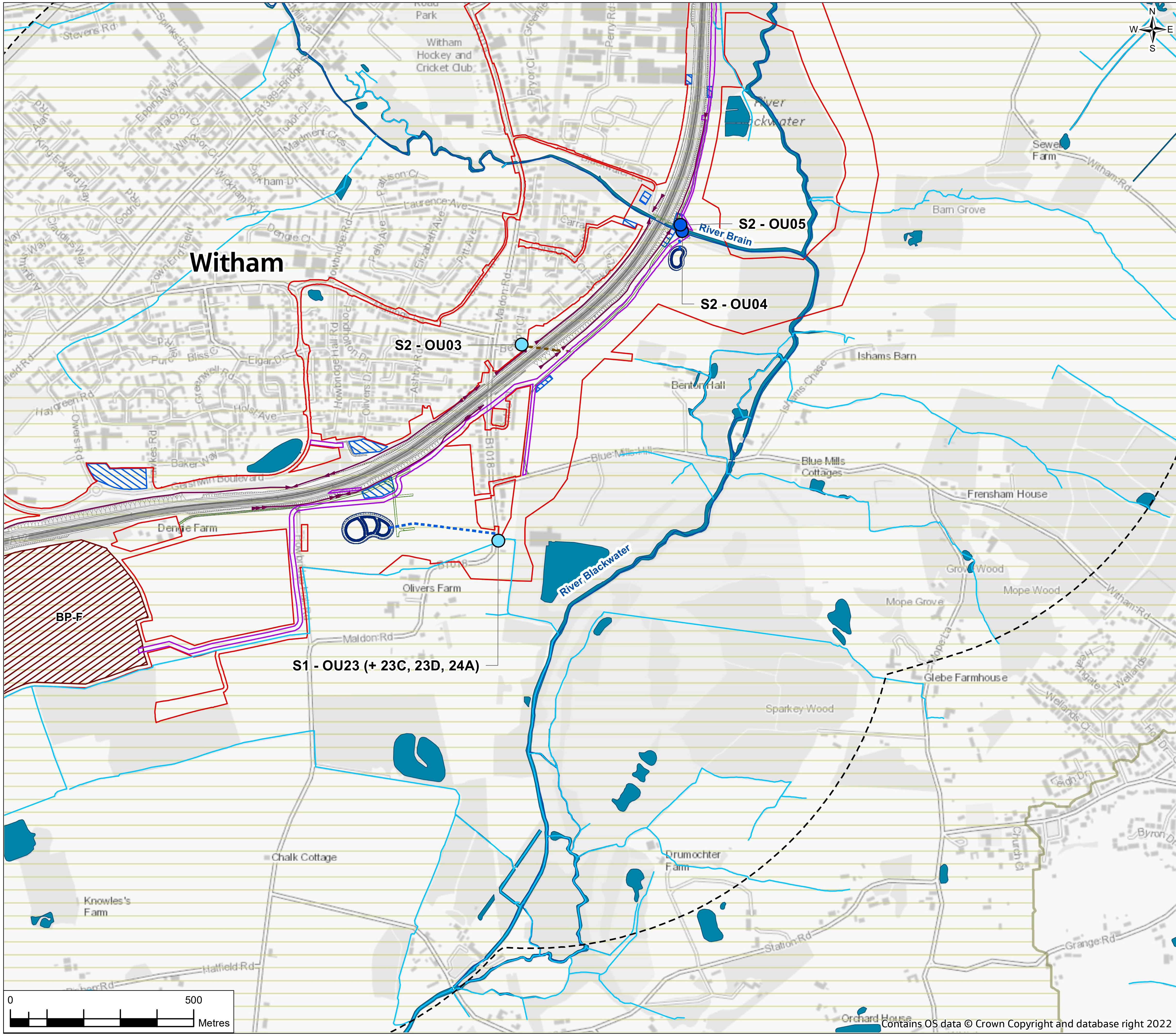

FIGURE 14.1.1

Legend

Proposed scheme

- Order Limits
- Study area
- Scheme
- Scheme culverts
- Cut-off ditch
- Temporary roads
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- Flood mitigation area

Low flow hydrology

Annual Q95 river flow m^3 / s

- ≤0.0011
- 0.0011 - 0.0100
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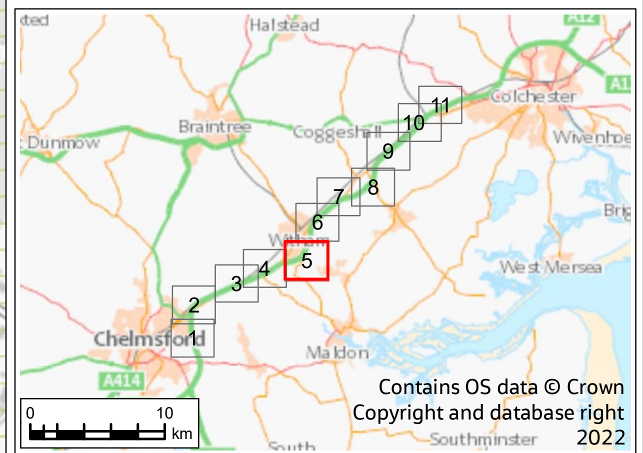
Water environment

- Main River
- Ordinary Watercourse
- Connection between proposed drainage pond and watercourse
- Existing water features (river, ponds, lakes and reservoirs)
- Drinking Water Safeguard Zone (surface water)



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Rev.	Rev. Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd

Development Consent Order Drawing Number: TR010060/APP/6.3

APFP Regulation: Regulation 5(2)(a)

Client

national highways

Project

REGIONAL DELIVERY PARTNERSHIP
A12 CHELMSFORD TO A120 WIDENING SCHEME

Drawing Title

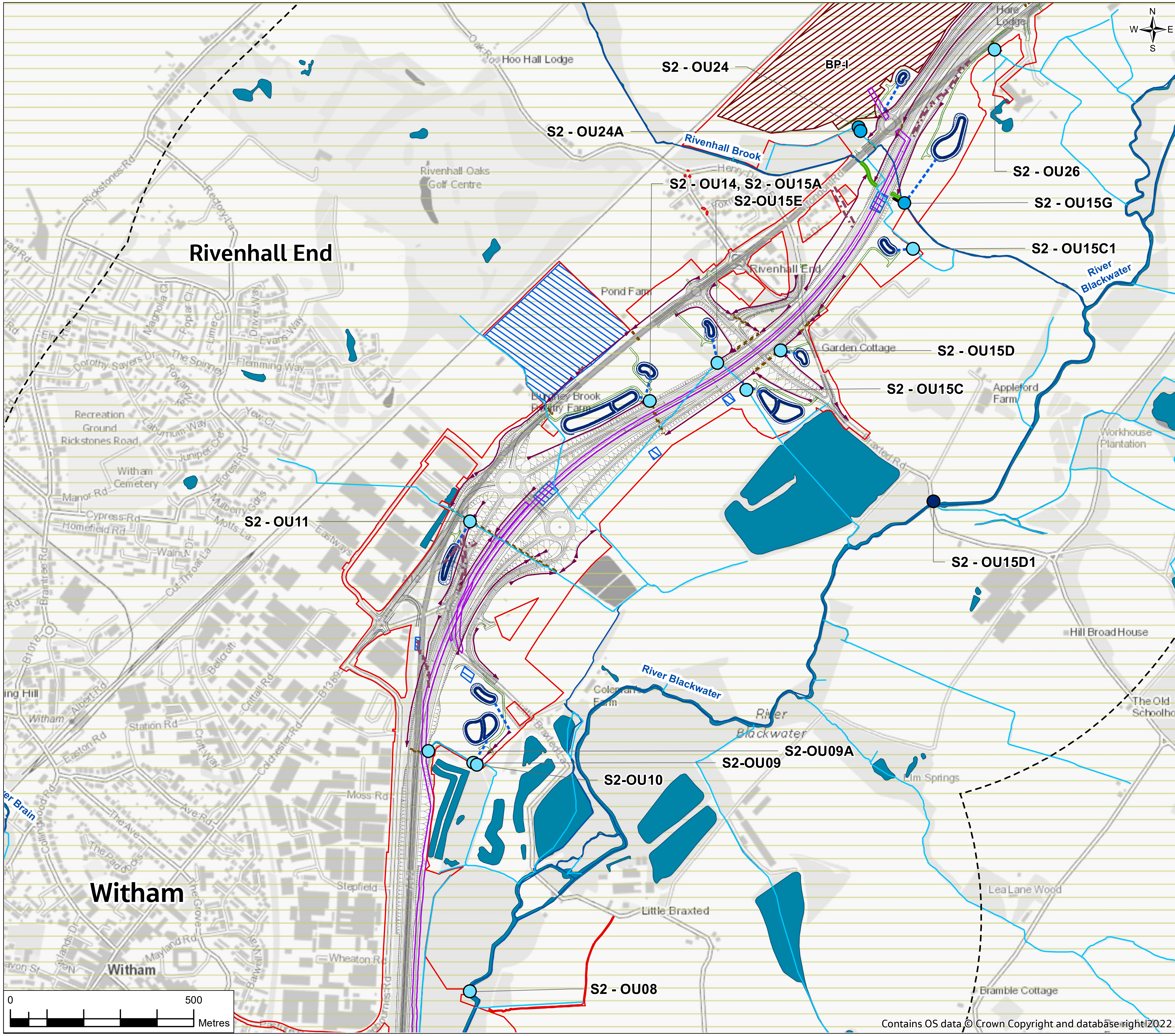
WATER QUALITY ASSESSMENT REPORT
LOW FLOW HYDROLOGY
SHEET 5 OF 11

Drawing Status: S4 - SUITABLE FOR STAGE APPROVAL

Scale @ A3	1:10000	DO NOT SCALE
Jacobs No.	B36601D1	
Client No.	HE551497	Rev P01

Drawing Number: HE551497-JAC-LDC-SCHW-SK-GI-0370

FIGURE 14.1.1



Legend

Proposed scheme

- Order Limits
- Study area
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- Flood mitigation area

Low flow hydrology

Annual Q95 river flow m^3 / s

- ≤0.0011
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Water environment

- Main River
- Ordinary Watercourse
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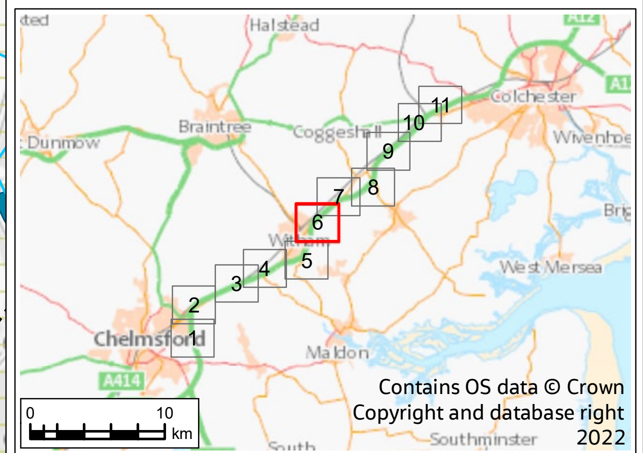

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Development Consent Order Drawing Number: TR010060/APP/6.3

APFP Regulation: Regulation 5(2)(a)

Client: national highways

Project: REGIONAL DELIVERY PARTNERSHIP
A12 CHELMSFORD TO A120 WIDENING SCHEME

Drawing Title: WATER QUALITY ASSESSMENT REPORT
LOW FLOW HYDROLOGY
SHEET 6 OF 11

Drawing Status: S4 - SUITABLE FOR STAGE APPROVAL

Scale @ A3	1:10000	DO NOT SCALE
Jacobs No.	B36601D1	
Client No.	HE551497	Rev P01

Drawing Number: HE551497-JAC-LDC-SCHW-SK-GI-0371

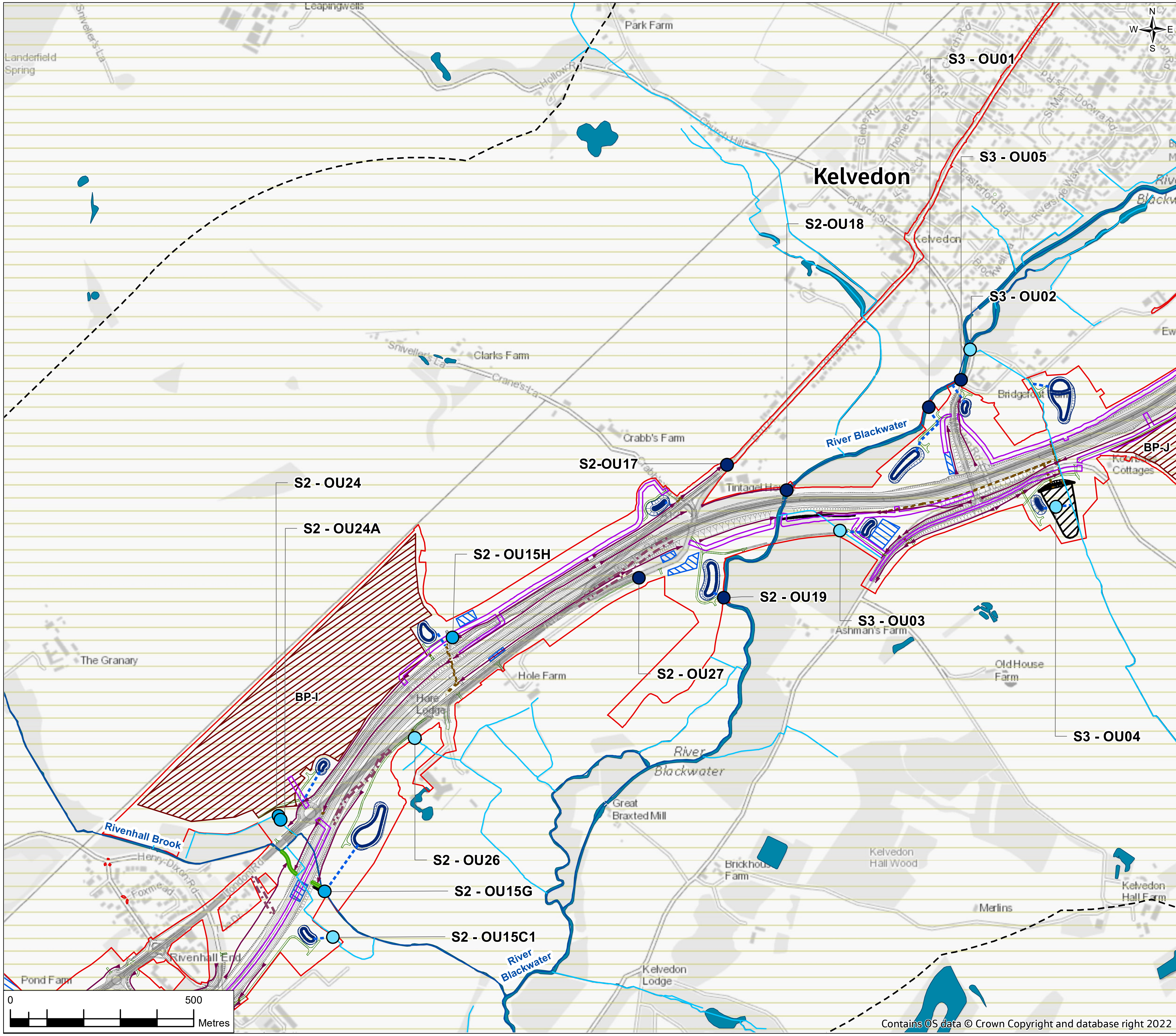

FIGURE 14.1.1

Legend

Proposed scheme

- Order Limits
- Study area
- Scheme
- Scheme culverts
- Cut-off ditch
- Temporary roads
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- Drainage pond
- Flood mitigation area

Low flow hydrology

Annual Q95 river flow m^3 / s

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Water environment

- Main River
- Ordinary Watercourse
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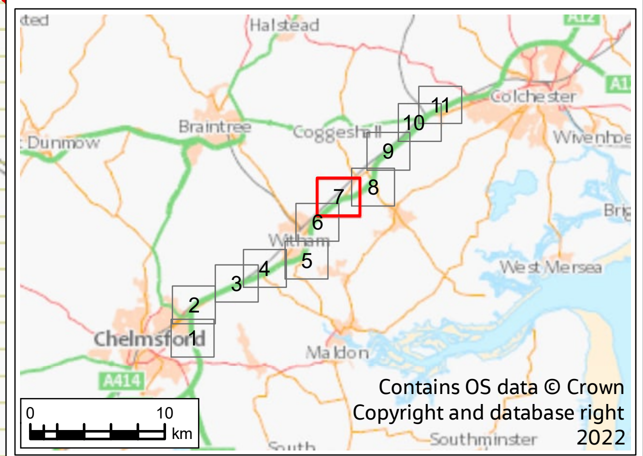

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Rev.	Rev. Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd

Development Consent Order Drawing Number: TR010060/APP/6.3

APFP Regulation: Regulation 5(2)(a)

Client

national highways

Project

REGIONAL DELIVERY PARTNERSHIP
A12 CHELMSFORD TO A120 WIDENING SCHEME

Drawing Title

WATER QUALITY ASSESSMENT REPORT
LOW FLOW HYDROLOGY
SHEET 7 OF 11

Drawing Status: S4 - SUITABLE FOR STAGE APPROVAL

Scale @ A3	1:10000	DO NOT SCALE
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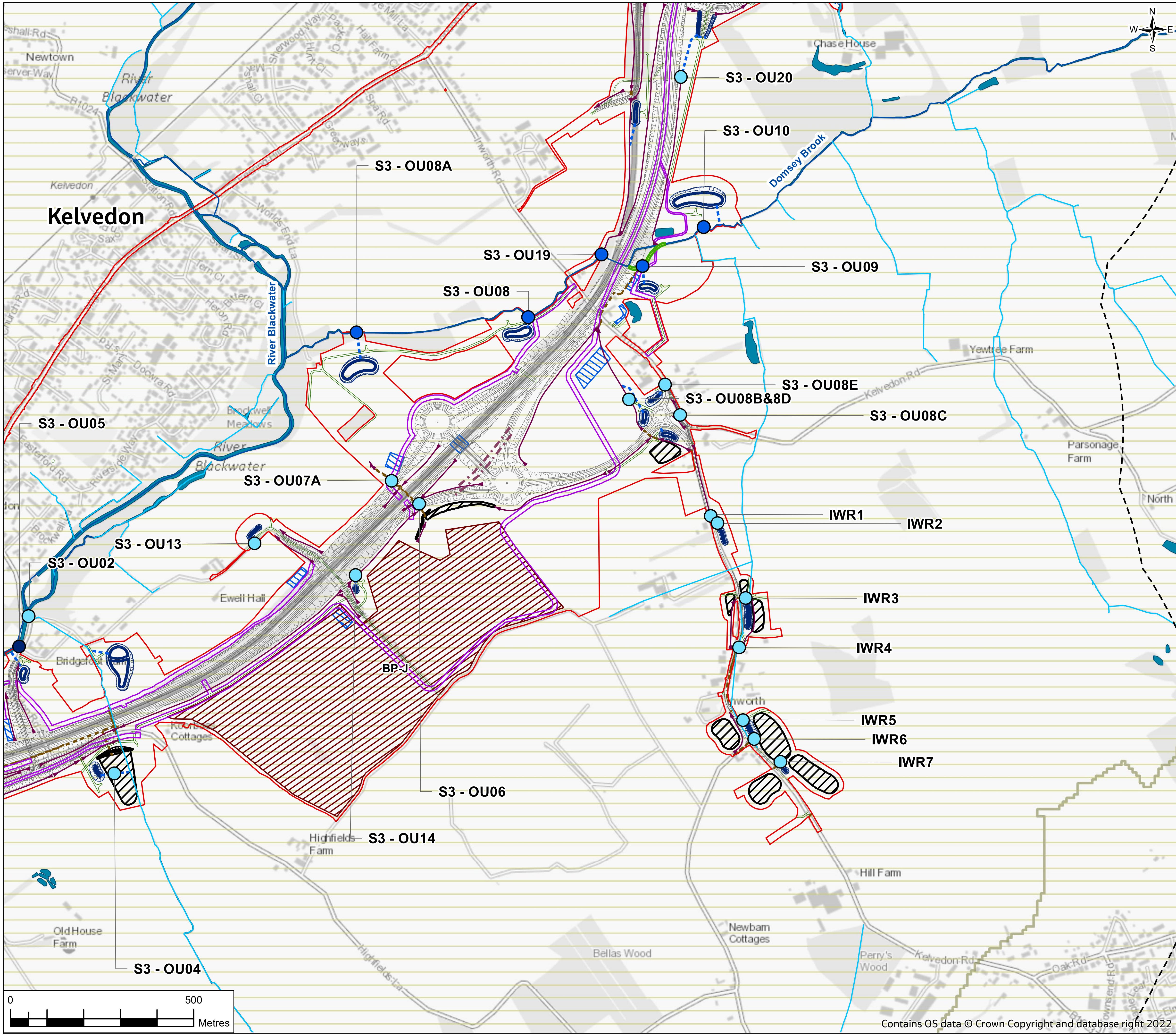
Client No.	HE551497	Rev P01

Drawing Number

HE551497-JAC-LDC-SCHW-SK-GI-0372

FIGURE 14.1.1



Legend

Proposed scheme

- Order Limits
- Study area
- Scheme
- Scheme culverts
- Cut-off ditch
- Temporary roads
- Private means of access and pond access tracks
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- Borrow pits
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- Drainage pond
- Flood mitigation area

Low flow hydrology

Annual Q95 river flow m^3 / s

- ≤0.0011
- 0.0011 - 0.0100
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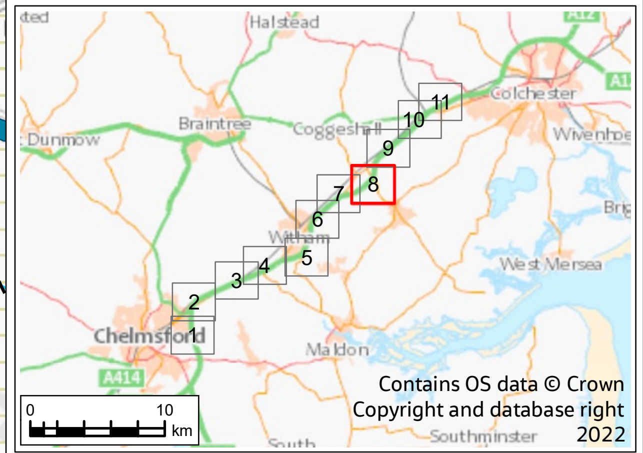
Water environment

- Main River
- Ordinary Watercourse
- Connection between proposed drainage pond and watercourse
- Existing water features (river, ponds, lakes and reservoirs)
- Drinking Water Safeguard Zone (surface water)



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Rev.	Rev. Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd

Development Consent Order Drawing Number: TR010060/APP/6.3

APFP Regulation: Regulation 5(2)(a)

Client: national highways

Project: REGIONAL DELIVERY PARTNERSHIP
A12 CHELMSFORD TO A120 WIDENING SCHEME

Drawing Title: WATER QUALITY ASSESSMENT REPORT
LOW FLOW HYDROLOGY
SHEET 8 OF 11

Drawing Status: S4 - SUITABLE FOR STAGE APPROVAL

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Client No.	HE551497	Rev P01

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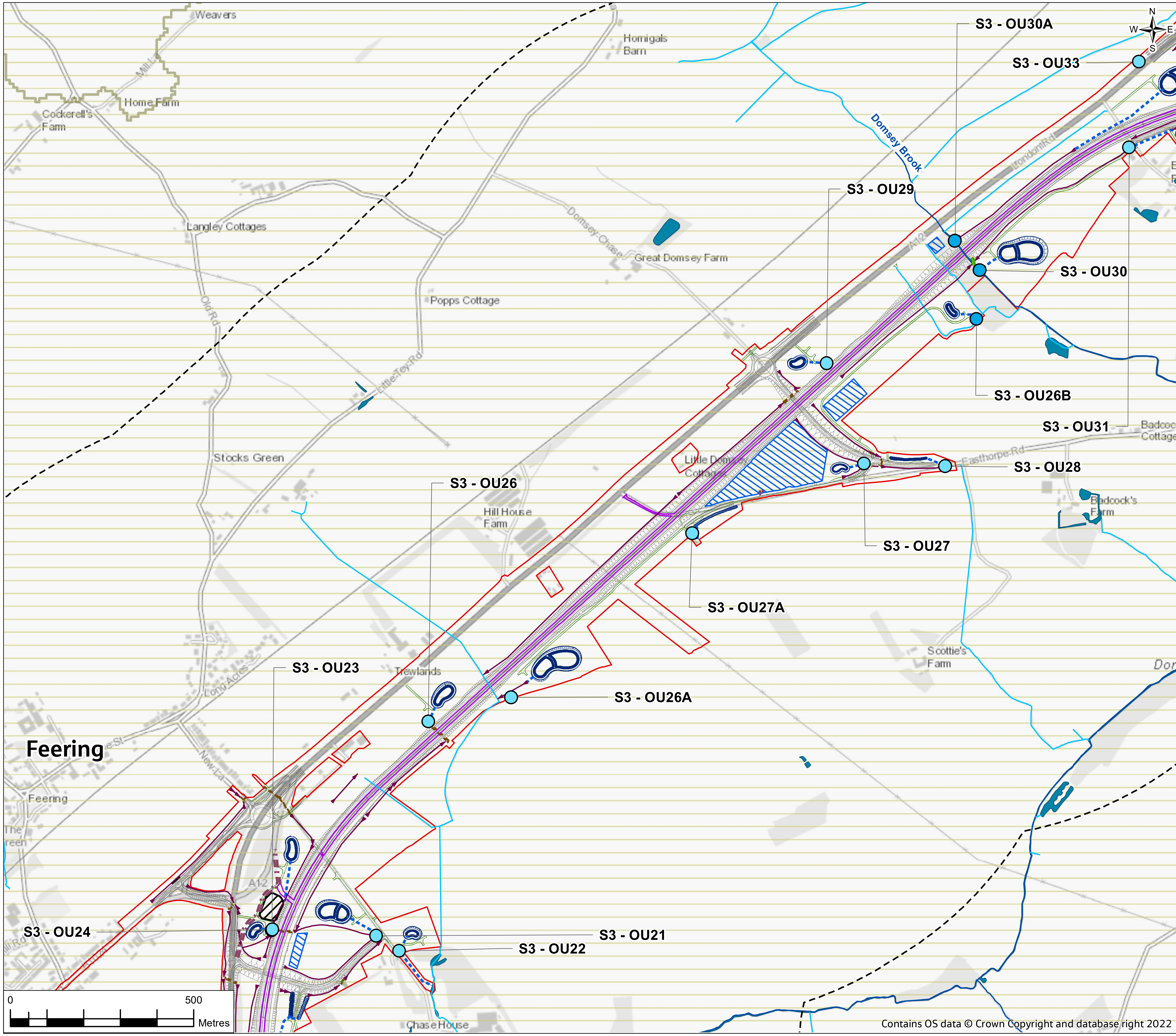

FIGURE 14.1.1

Legend

Proposed scheme

- Order Limits
- Study area
- Scheme
- Scheme culverts
- Cut-off ditch
- Temporary roads
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Low flow hydrology

Annual Q95 river flow m^3 / s

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- 0.0011 - 0.0100
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Water environment

- Main River
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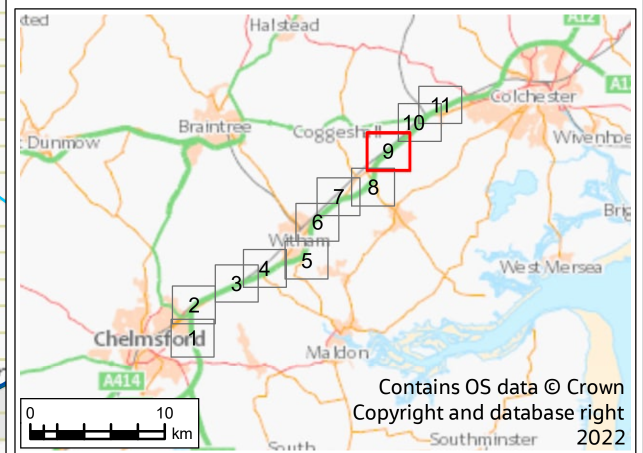

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Development Consent Order Drawing Number: TR010060/APP/6.3

APFP Regulation: Regulation 5(2)(a)

Client: national highways

Project: REGIONAL DELIVERY PARTNERSHIP
A12 CHELMSFORD TO A120 WIDENING SCHEME

Drawing Title: WATER QUALITY ASSESSMENT REPORT
LOW FLOW HYDROLOGY
SHEET 9 OF 11

Drawing Status: S4 - SUITABLE FOR STAGE APPROVAL

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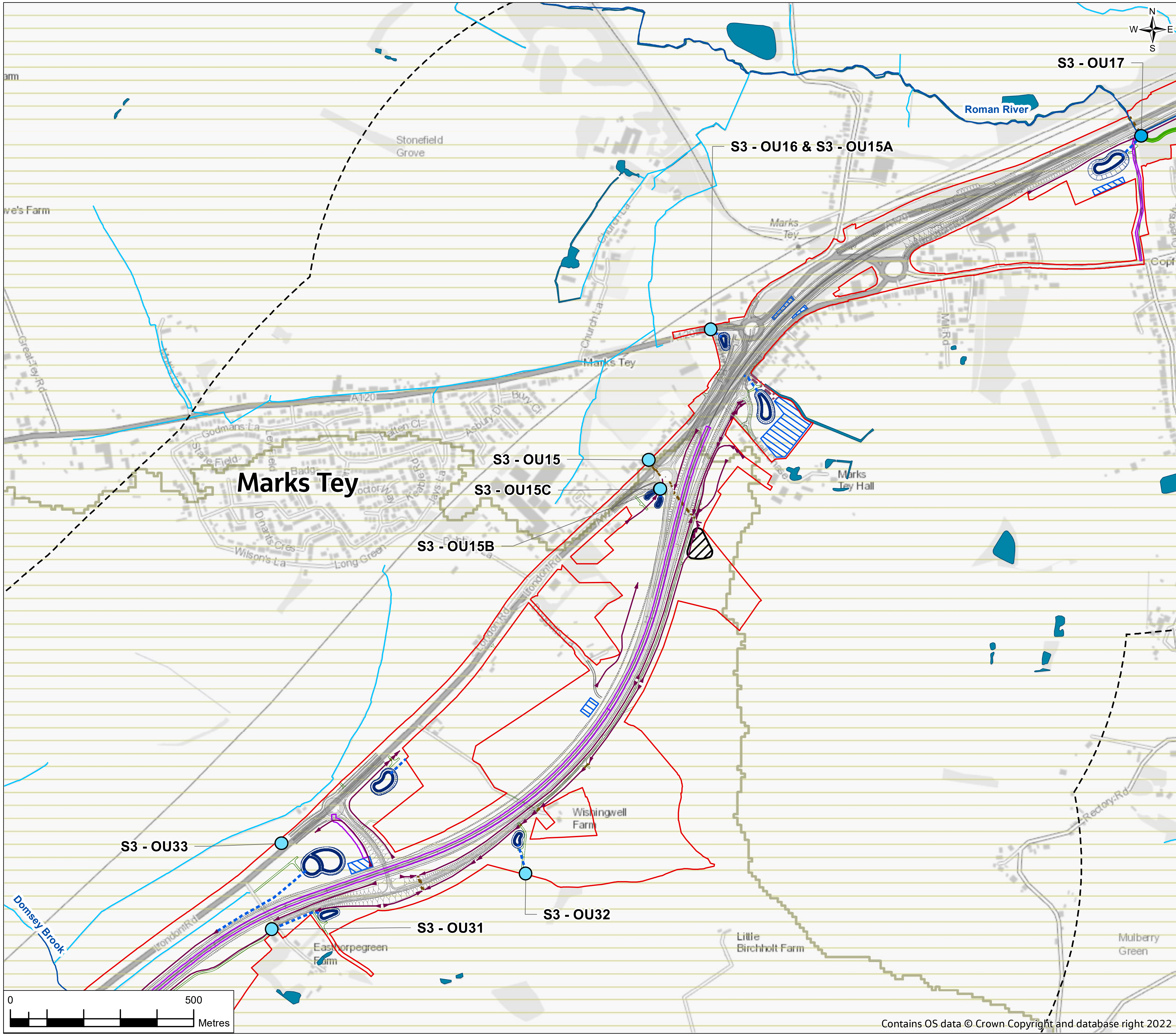

FIGURE 14.1.1

Legend

Proposed scheme

- Order Limits
- Study area
- Scheme
- Scheme culverts
- Cut-off ditch
- Temporary roads
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Low flow hydrology

Annual Q95 river flow m^3 / s

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Water environment

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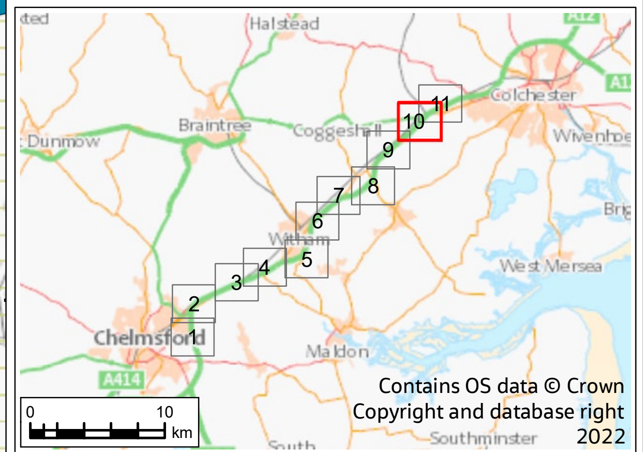

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Rev.	Rev. Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd

Development Consent Order Drawing Number: TR010060/APP/6.3

APFP Regulation: Regulation 5(2)(a)

Client

national highways

Project

REGIONAL DELIVERY PARTNERSHIP
A12 CHELMSFORD TO A120 WIDENING SCHEME

Drawing Title

WATER QUALITY ASSESSMENT REPORT
LOW FLOW HYDROLOGY
SHEET 10 OF 11

Drawing Status: S4 - SUITABLE FOR STAGE APPROVAL

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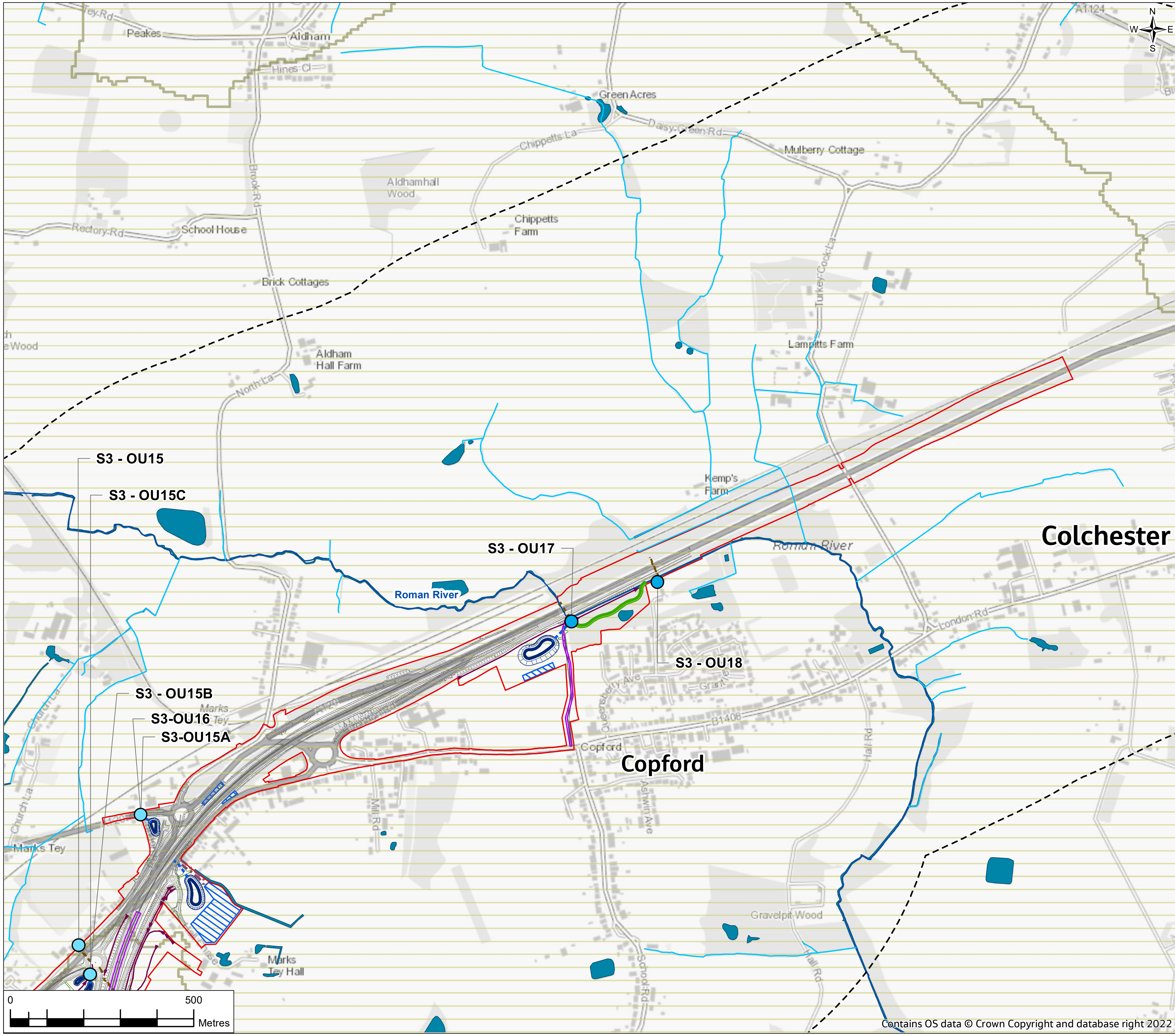

FIGURE 14.1.1

Legend

Proposed scheme

- Order Limits
- Study area
- Scheme
- Scheme culverts
- Cut-off ditch
- Temporary roads
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- Haul roads
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- Borrow pits
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- Flood mitigation area

Low flow hydrology

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Water environment

- Main River
- Ordinary Watercourse
- Connection between proposed drainage pond and watercourse
- Existing water features (river, ponds, lakes and reservoirs)
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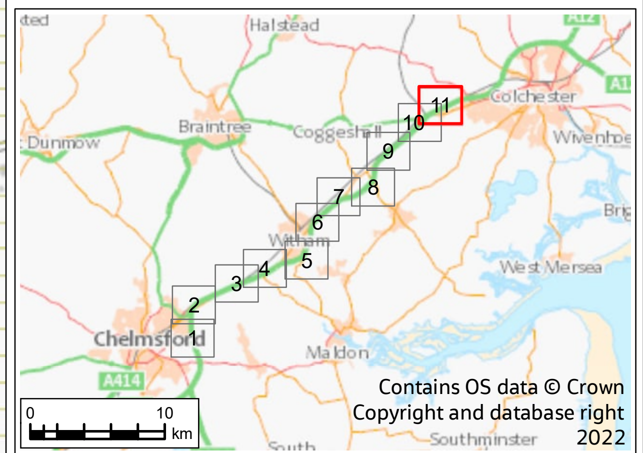

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APFP Regulation: Regulation 5(2)(a)

Client: national highways

Project: REGIONAL DELIVERY PARTNERSHIP
A12 CHELMSFORD TO A120 WIDENING SCHEME

Drawing Title: WATER QUALITY ASSESSMENT REPORT
LOW FLOW HYDROLOGY
SHEET 11 OF 11

Drawing Status: S4 - SUITABLE FOR STAGE APPROVAL

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Client No.	HE551497	Rev P01

Drawing Number: HE551497-JAC-LDC-SCHW-SK-GI-0376

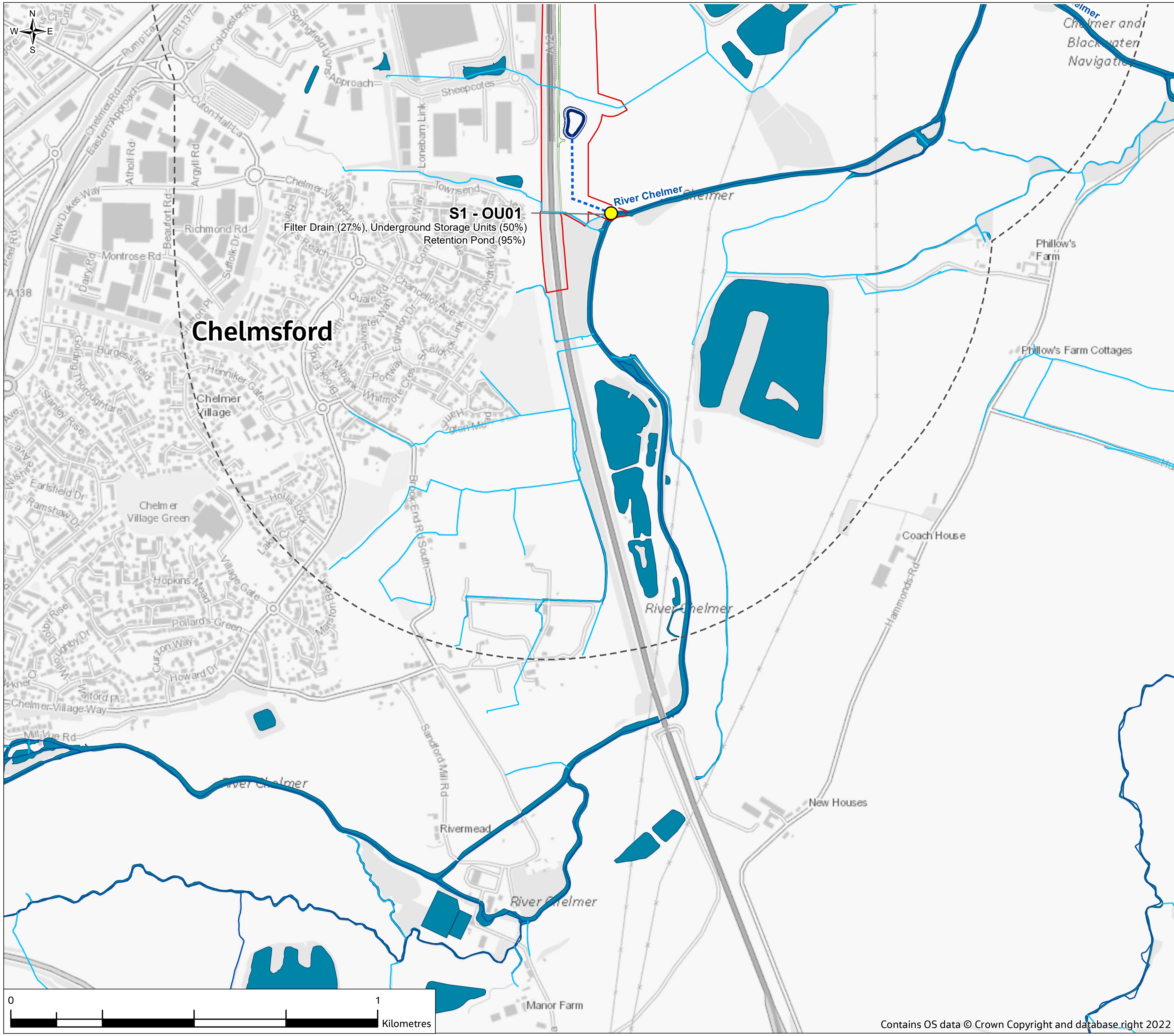


FIGURE 14.1.2

Legend

Proposed scheme

- Order Limits
- Scheme
- Study area
- Private means of access and pond access tracks
- Connection between proposed drainage pond and watercourse
- Drainage pond

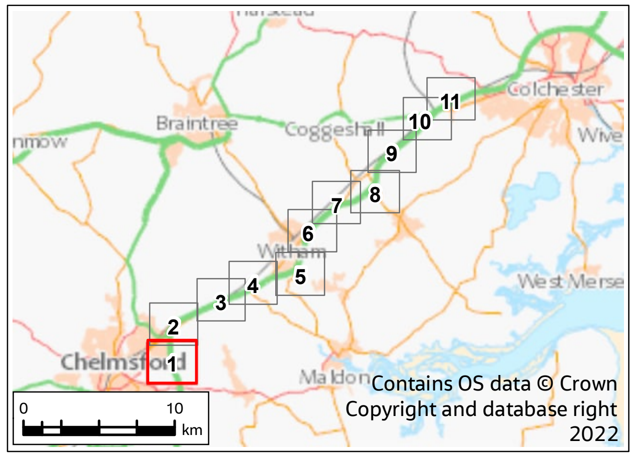
Single outfall assessment results: residual effects

- Neutral
- Slight adverse

Water environment

- Main River
- Ordinary Watercourse
- Existing water features (river, ponds, lakes and reservoirs)

Note:
1. In some locations outfalls discharge to cut-off ditches, these are not currently presented.
2. Abbreviation meaning:
"S1" - Section 1, "S2" - Section 2, "S3" - Section 3, "IWR" - Inworth Road.



Rev.	Rev. Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd
P01	04/08/22	For DCO application	SSz	CW	DS	SG

Development Consent Order Drawing Number: TR010060/APP/6.3

APFP Regulation: Regulation 5(2)(a)

Client

national highways

Project

REGIONAL DELIVERY PARTNERSHIP
A12 CHELMSFORD TO A120 WIDENING SCHEME

Drawing Title

WATER QUALITY ASSESSMENT REPORT
SINGLE OUTFALL ASSESSMENT RESULTS
SHEET 1 OF 11

Drawing Status: S4 - SUITABLE FOR STAGE APPROVAL

Scale @ A3	1:10000	DO NOT SCALE
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Client No.	HE551497	Rev P01

Drawing Number: HE551497-JAC-LDC-SCHW-SK-GI-0377

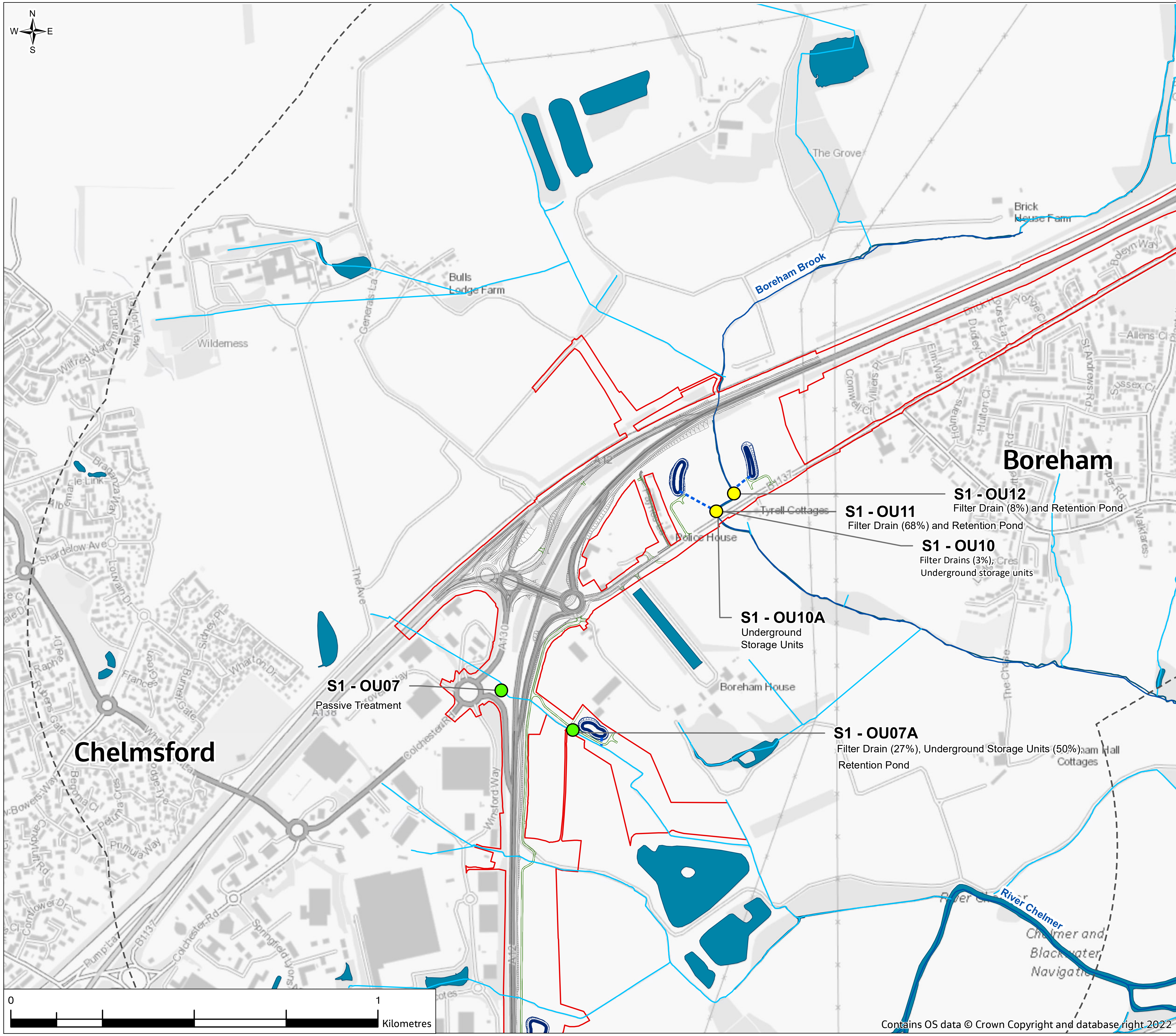


FIGURE 14.1.2

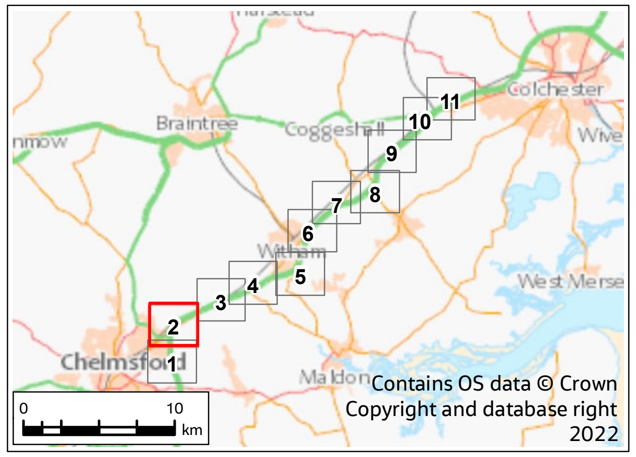
Legend

Proposed scheme
- Order Limits
- Scheme
- Study area
- Private means of access and pond access tracks
- Connection between proposed drainage pond and watercourse
- Drainage pond

Single outfall assessment results: residual effects
- Neutral
- Slight adverse

Water environment
- Main River
- Ordinary Watercourse
- Existing water features (river, ponds, lakes and reservoirs)

Note:
1. In some locations outfalls discharge to cut-off ditches, these are not currently presented.
2. Abbreviation meaning:
"S1" - Section 1, "S2" - Section 2, "S3" - Section 3, "IWR" - Inworth Road.



Rev.	Rev. Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd
P01	04/08/22	For DCO application	SSz	CW	DS	SG

Development Consent Order Drawing Number: TR010060/APP/6.3

APFP Regulation: Regulation 5(2)(a)

Client: national highways

Project: REGIONAL DELIVERY PARTNERSHIP
A12 CHELMSFORD TO A120 WIDENING SCHEME

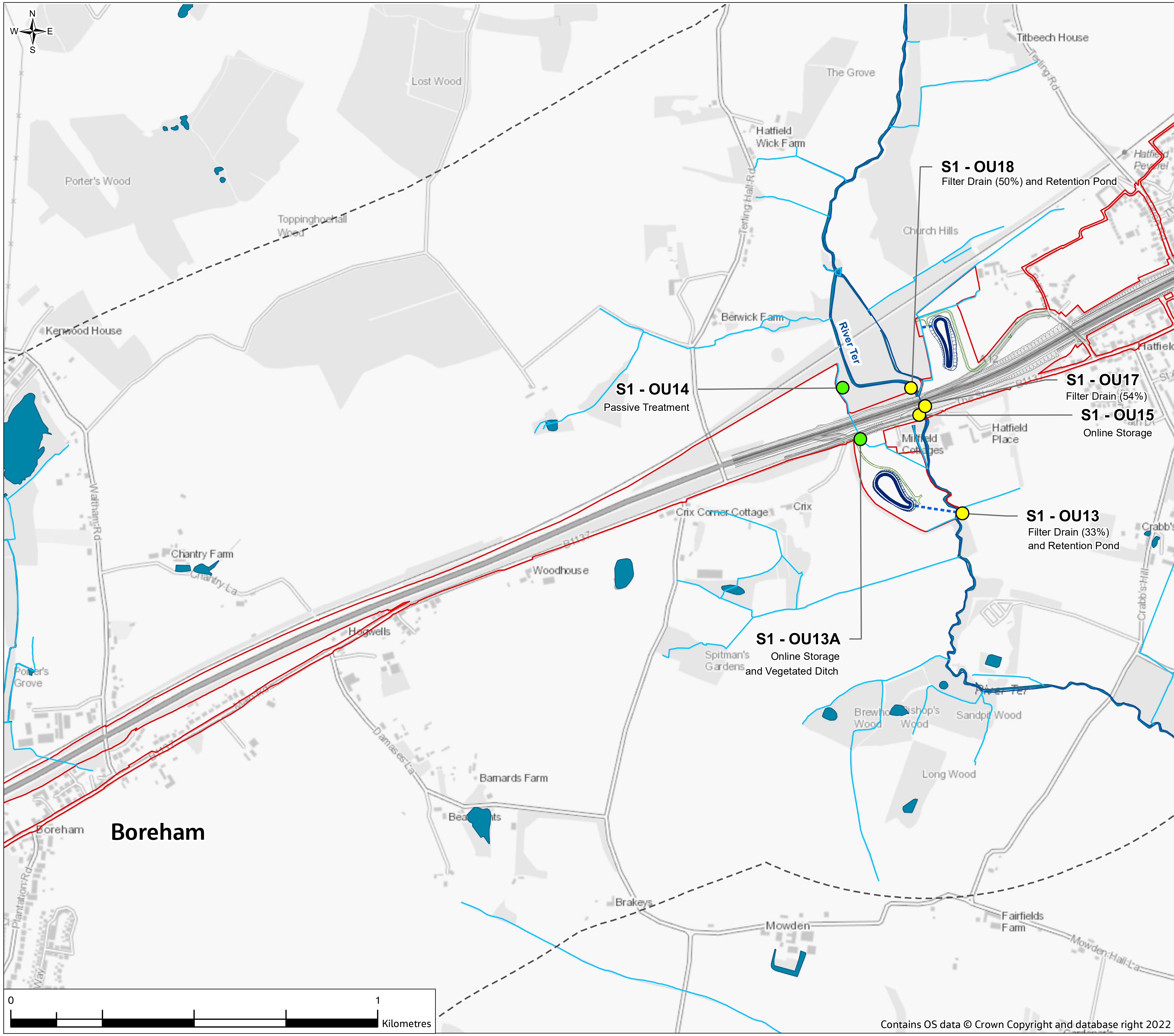
Drawing Title: WATER QUALITY ASSESSMENT REPORT
SINGLE OUTFALL ASSESSMENT RESULTS
SHEET 2 OF 11

Drawing Status: S4 - SUITABLE FOR STAGE APPROVAL

Scale @ A3	1:10000	DO NOT SCALE
Jacobs No.	B36601D1	
Client No.	HE551497	Rev P01

Drawing Number: HE551497-JAC-LDC-SCHW-SK-GI-0378

FIGURE 14.1.2



Legend

Proposed scheme

- Order Limits
- Scheme
- Study area
- Private means of access and pond access tracks
- Connection between proposed drainage pond and watercourse
- Drainage pond

Single outfall assessment results: residual effects

- Neutral
- Slight adverse

Water environment

- Main River
- Ordinary Watercourse
- Existing water features (river, ponds, lakes and reservoirs)

Note:
1. In some locations outfalls discharge to cut-off ditches, these are not currently presented.
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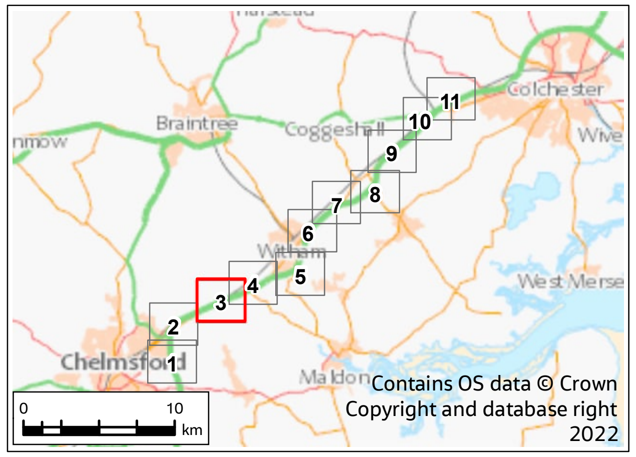


P01	04/08/22	For DCO application	SSz	CW	DS	SG
Rev.	Rev. Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd

Development Consent Order Drawing Number: TR010060/APP/6.3

APFP Regulation: Regulation 5(2)(a)

Client: national highways

Project: REGIONAL DELIVERY PARTNERSHIP
A12 CHELMSFORD TO A120 WIDENING SCHEME

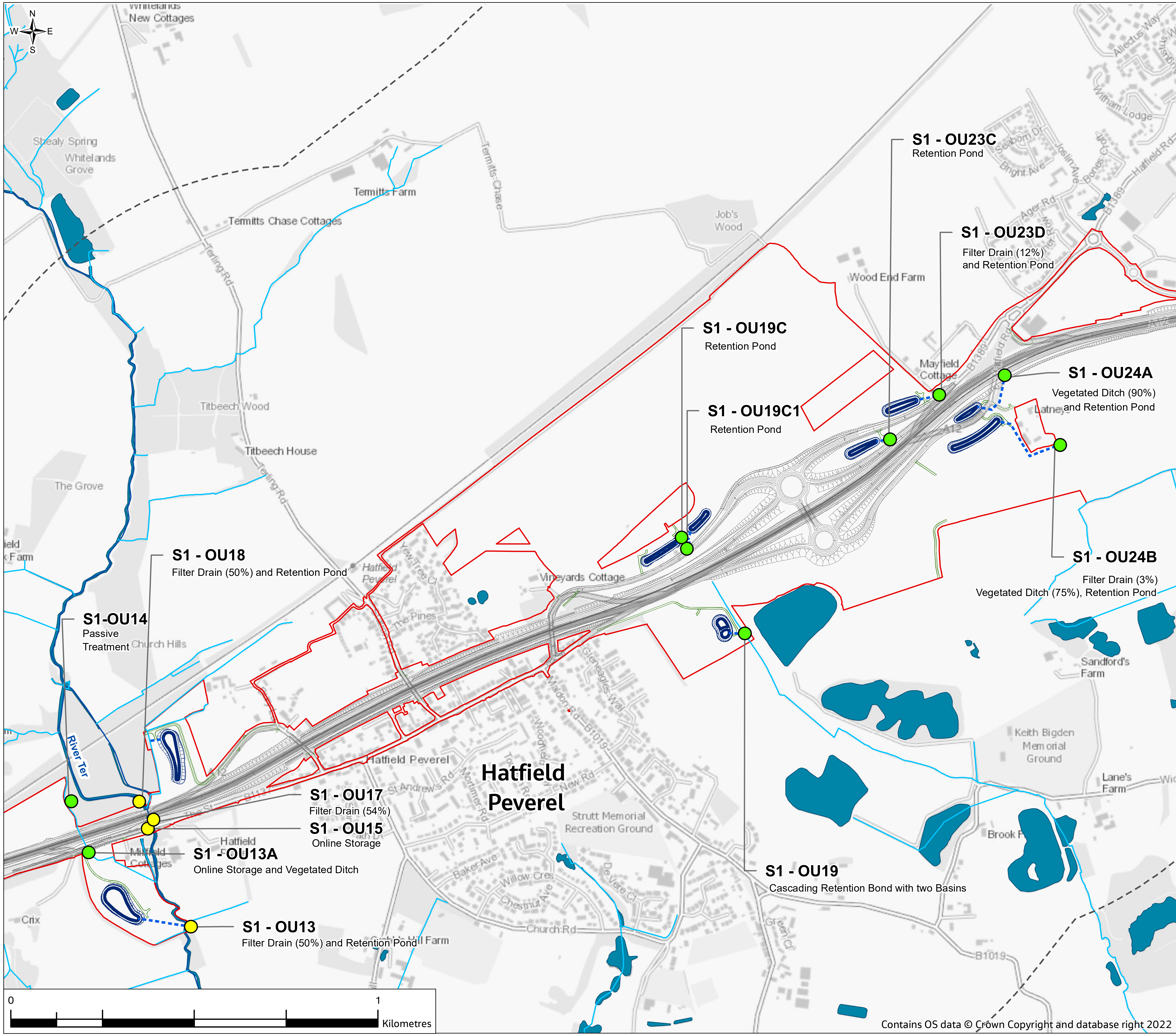
Drawing Title: WATER QUALITY ASSESSMENT REPORT
SINGLE OUTFALL ASSESSMENT RESULTS
SHEET 3 OF 11

Drawing Status: S4 - SUITABLE FOR STAGE APPROVAL

Scale @ A3	1:10000	DO NOT SCALE	
Jacobs No.	B36601D1		
Client No.	HE551497	Rev	P01

Drawing Number: HE551497-JAC-LDC-SCHW-SK-GI-0379

FIGURE 14.1.2



Legend

Proposed scheme

- Order Limits
- Scheme
- Study area
- Private means of access and pond access tracks
- Connection between proposed drainage pond and watercourse
- Drainage pond

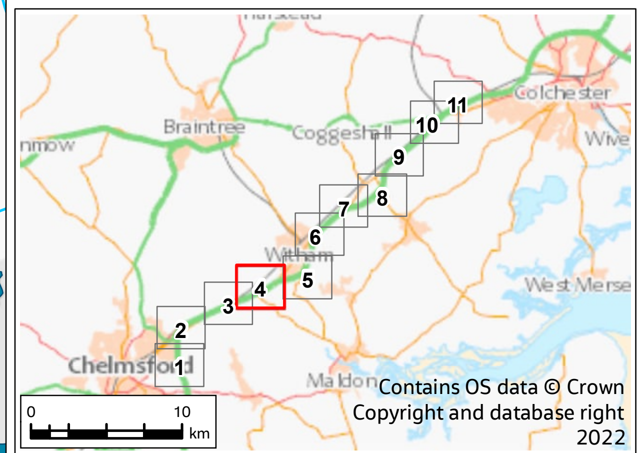
Single outfall assessment results: residual effects

- Neutral
- Slight adverse

Water environment

- Main River
- Ordinary Watercourse
- Existing water features (river, ponds, lakes and reservoirs)

Note:
1. In some locations outfalls discharge to cut-off ditches, these are not currently presented.
2. Abbreviation meaning:
"S1" - Section 1, "S2" - Section 2, "S3" - Section 3, "IWR" - Inworth Road.



Rev.	Rev. Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd
P01	04/08/22	For DCO application	SSz	CW	DS	SG

Development Consent Order Drawing Number: TR010060/APP/6.3

APFP Regulation: Regulation 5(2)(a)

Client: national highways

Project: REGIONAL DELIVERY PARTNERSHIP
A12 CHELMSFORD TO A120 WIDENING SCHEME

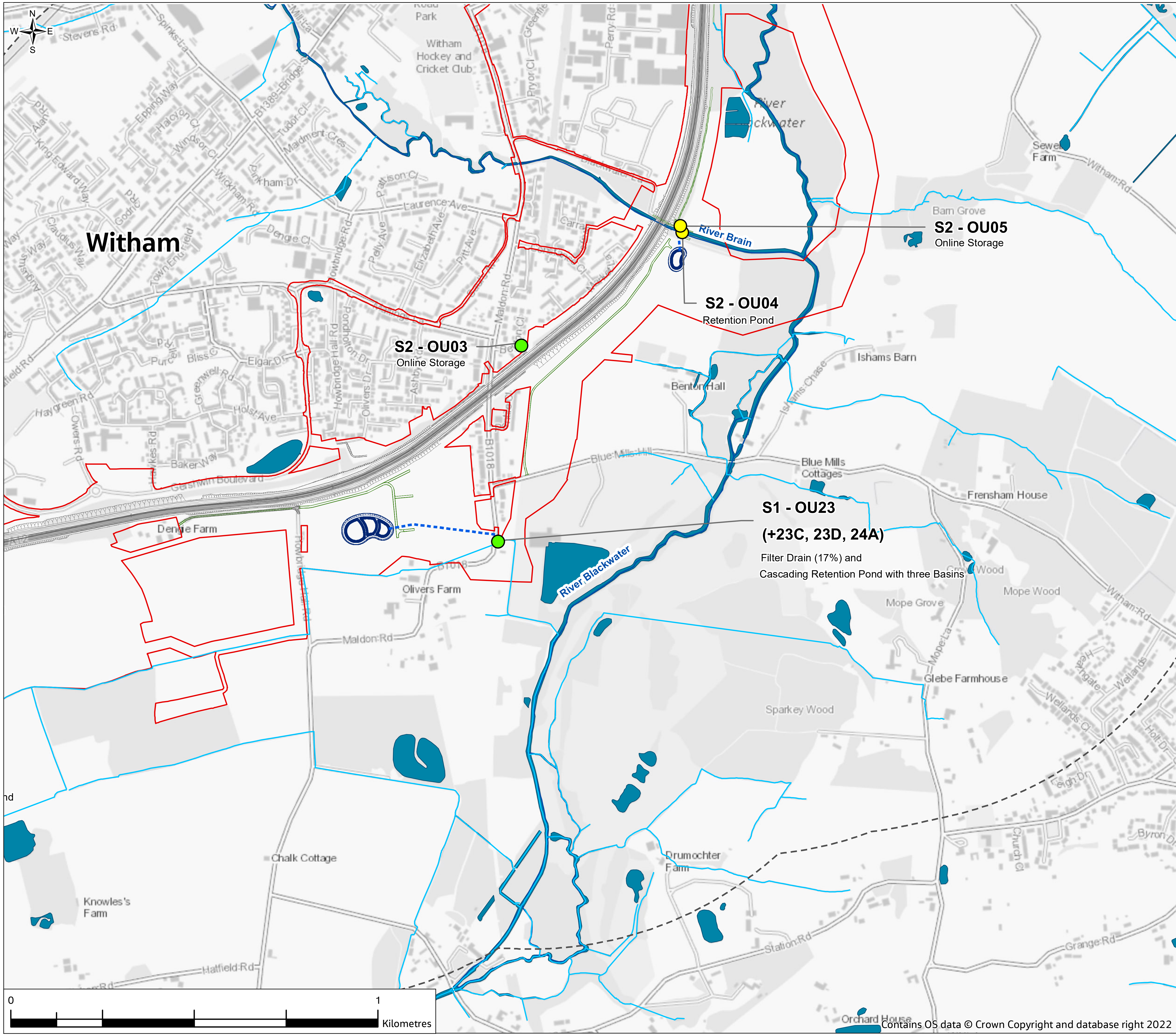
Drawing Title: WATER QUALITY ASSESSMENT REPORT
SINGLE OUTFALL ASSESSMENT RESULTS
SHEET 4 OF 11

Drawing Status: S4 - SUITABLE FOR STAGE APPROVAL

Scale @ A3	1:10000	DO NOT SCALE	
Jacobs No.	B36601D1		
Client No.	HE551497	Rev	P01

Drawing Number: HE551497-JAC-LDC-SCHW-SK-GI-0380

FIGURE 14.1.2



Legend

Proposed scheme
- Order Limits
- Scheme
- Study area
- Private means of access and pond access tracks
- Connection between proposed drainage pond and watercourse
- Drainage pond

Single outfall assessment results: residual effects
- Neutral
- Slight adverse

Water environment
- Main River
- Ordinary Watercourse
- Existing water features (river, ponds, lakes and reservoirs)

Note:
1. In some locations outfalls discharge to cut-off ditches, these are not currently presented.
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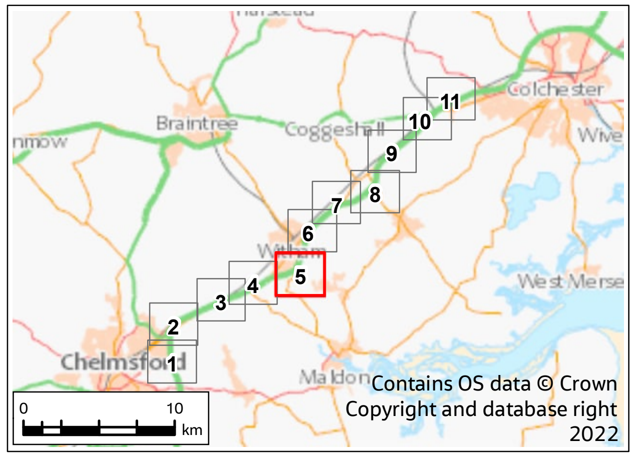
"S1" - Section 1, "S2" - Section 2, "S3" - Section 3, "IWR" - Inworth Road.



P01	04/08/22	For DCO application	SSz	CW	DS	SG
Rev.	Rev. Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd

Development Consent Order Drawing Number: TR010060/APP/6.3

APFP Regulation: Regulation 5(2)(a)

Client

national highways

Project

REGIONAL DELIVERY PARTNERSHIP
A12 CHELMSFORD TO A120 WIDENING SCHEME

Drawing Title

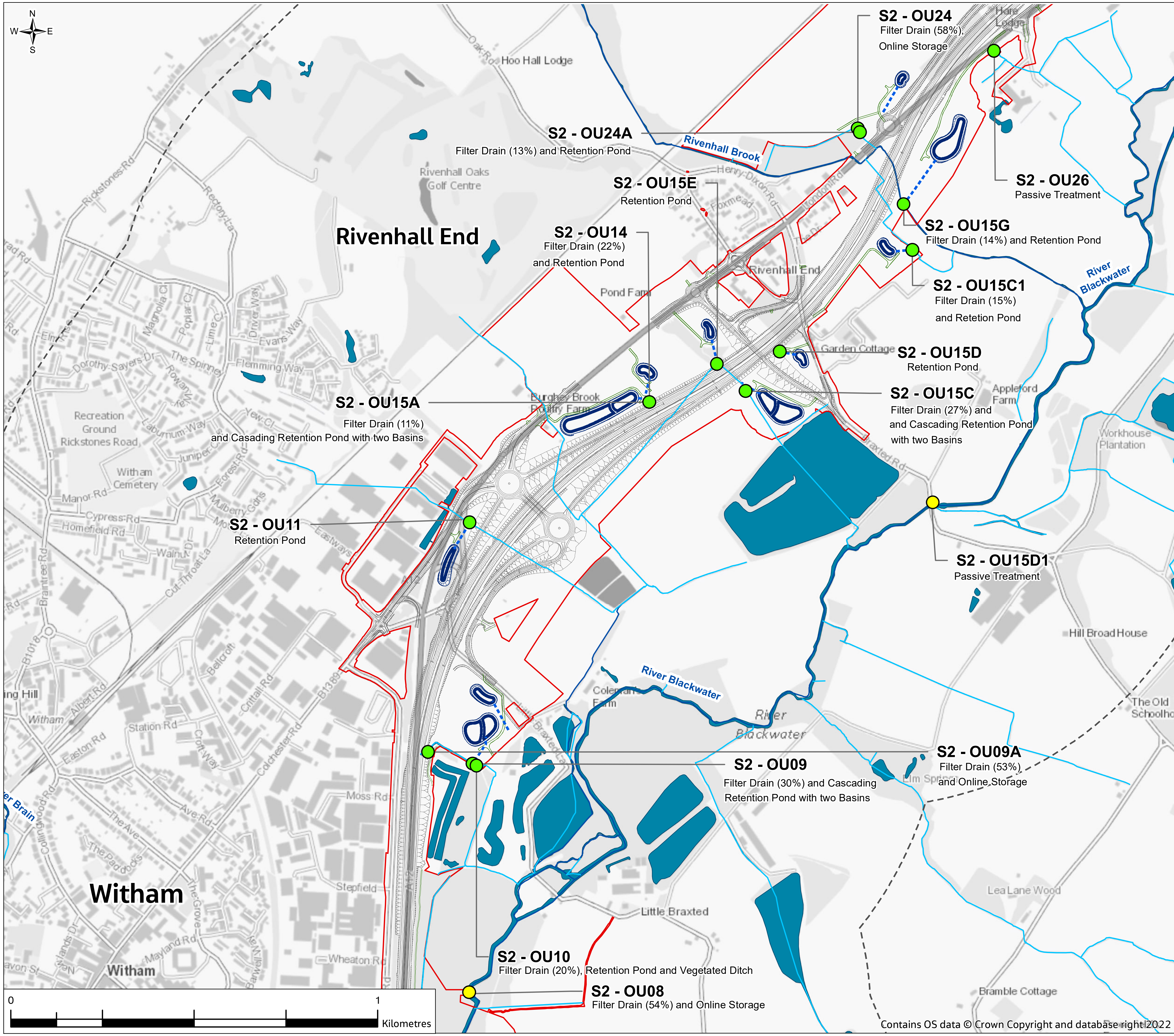
WATER QUALITY ASSESSMENT REPORT
SINGLE OUTFALL ASSESSMENT RESULTS
SHEET 5 OF 11

Drawing Status: S4 - SUITABLE FOR STAGE APPROVAL

Scale @ A3	1:10000	DO NOT SCALE
Jacobs No.	B36601D1	
Client No.	HE551497	Rev P01

Drawing Number: HE551497-JAC-LDC-SCHW-SK-GI-0381

FIGURE 14.1.2



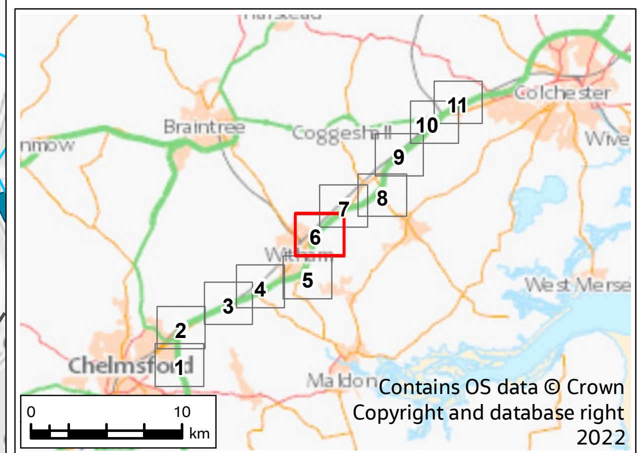
Legend

Proposed scheme
- Order Limits
- Scheme
- Study area
- Private means of access and pond access tracks
- Connection between proposed drainage pond and watercourse
- Drainage pond

Single outfall assessment results: residual effects
- Neutral
- Slight adverse

Water environment
- Main River
- Ordinary Watercourse
- Existing water features (river, ponds, lakes and reservoirs)

Note:
1. In some locations outfalls discharge to cut-off ditches, these are not currently presented.
2. Abbreviation meaning:
"S1" - Section 1, "S2" - Section 2, "S3" - Section 3, "IWR" - Inworth Road.



Rev.	Rev. Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd
P01	04/08/22	For DCO application	SSz	CW	DS	SG

Development Consent Order Drawing Number: TR010060/APP/6.3

APFP Regulation: Regulation 5(2)(a)

Client: national highways

Project: REGIONAL DELIVERY PARTNERSHIP
A12 CHELMSFORD TO A120 WIDENING SCHEME

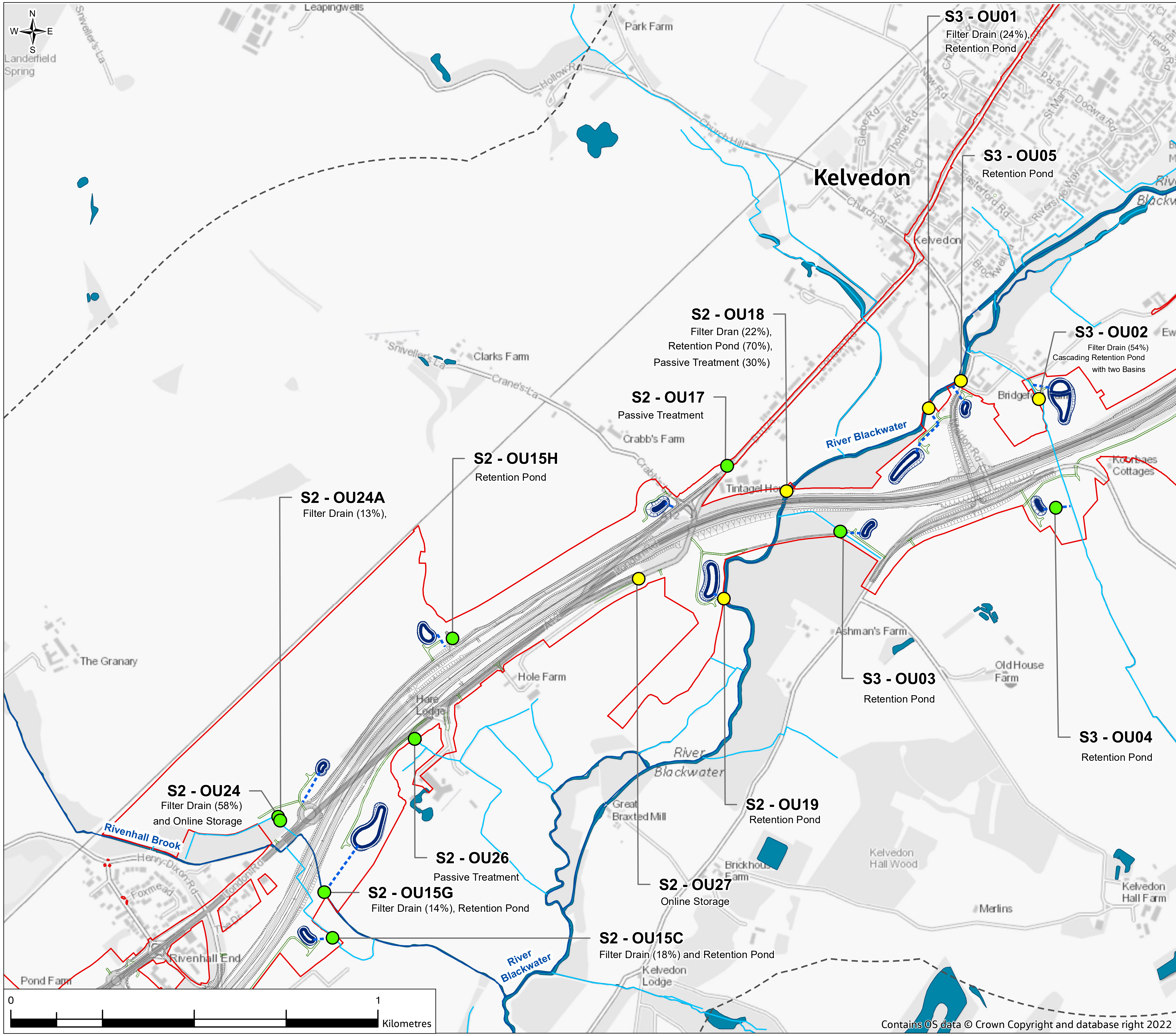
Drawing Title: WATER QUALITY ASSESSMENT REPORT
SINGLE OUTFALL ASSESSMENT RESULTS
SHEET 6 OF 11

Drawing Status: S4 - SUITABLE FOR STAGE APPROVAL

Scale @ A3	1:10000	DO NOT SCALE
Jacobs No.	B36601D1	
Client No.	HE551497	Rev P01

Drawing Number: HE551497-JAC-LDC-SCHW-SK-GI-0382

FIGURE 14.1.2



Legend

Proposed scheme

- Order Limits
- Scheme
- Study area
- Private means of access and pond access tracks
- Connection between proposed drainage pond and watercourse
- Drainage pond

Single outfall assessment results: residual effects

- Neutral
- Slight adverse

Water environment

- Main River
- Ordinary Watercourse
- Existing water features (river, ponds, lakes and reservoirs)

Note:
1. In some locations outfalls discharge to cut-off ditches, these are not currently presented.
2. Abbreviation meaning:
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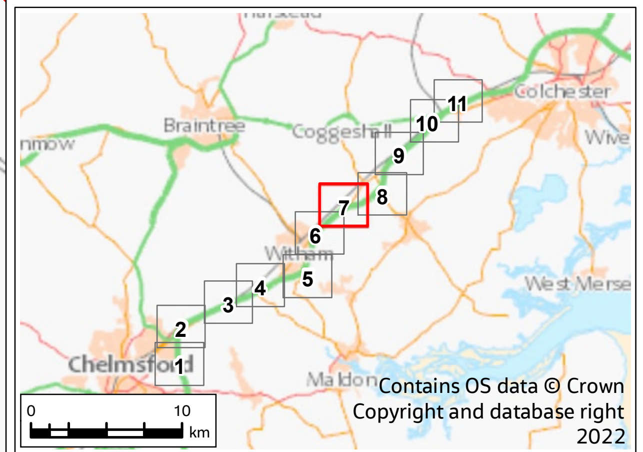


P01	04/08/22	For DCO application	SSz	CW	DS	SG
Rev.	Rev. Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd

Development Consent Order Drawing Number: TR010060/APP/6.3

APFP Regulation: Regulation 5(2)(a)

Client: national highways

Project: REGIONAL DELIVERY PARTNERSHIP
A12 CHELMSFORD TO A120 WIDENING SCHEME

Drawing Title: WATER QUALITY ASSESSMENT REPORT
SINGLE OUTFALL ASSESSMENT RESULTS
SHEET 7 OF 11

Drawing Status: S4 - SUITABLE FOR STAGE APPROVAL

Scale @ A3	1:10000	DO NOT SCALE	
Jacobs No.	B36601D1		
Client No.	HE551497	Rev	P01

Drawing Number: HE551497-JAC-LDC-SCHW-SK-GI-0383

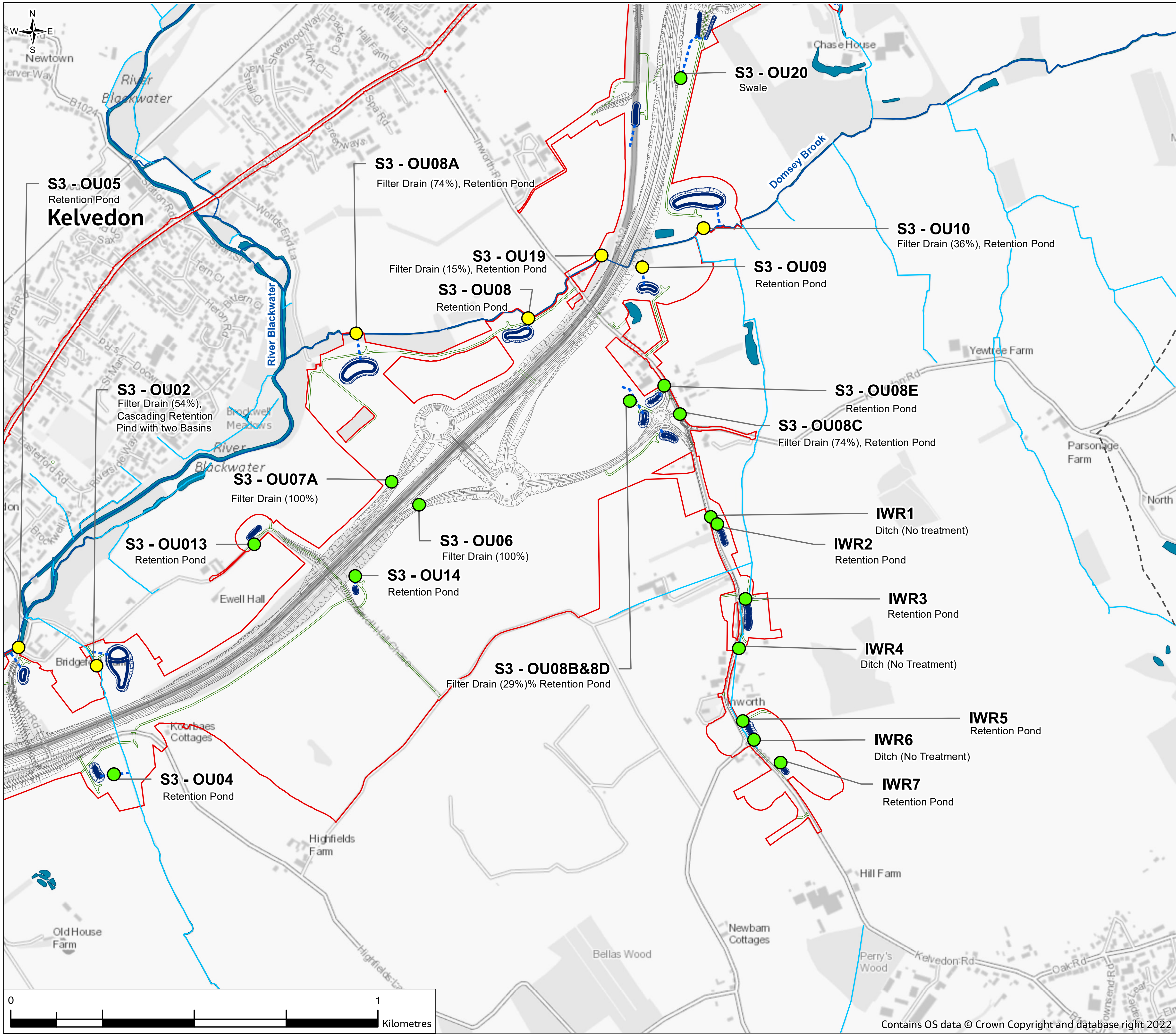


FIGURE 14.1.2

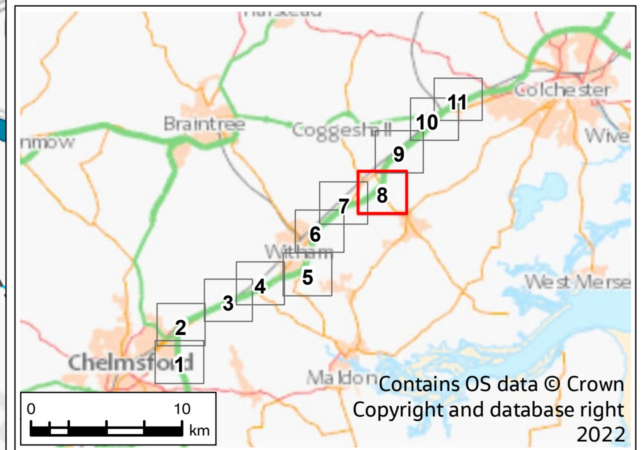
Legend

Proposed scheme
- Order Limits
- Scheme
- Study area
- Private means of access and pond access tracks
- Connection between proposed drainage pond and watercourse
- Drainage pond

Water environment
- Main River
- Ordinary Watercourse
- Existing water features (river, ponds, lakes and reservoirs)

Single outfall assessment results: residual effects
- Neutral
- Slight adverse

Note:
1. In some locations outfalls discharge to cut-off ditches, these are not currently presented.
2. Abbreviation meaning:
"S1" - Section 1, "S2" - Section 2, "S3" - Section 3, "IWR" - Inworth Road.



P01	04/08/22	For DCO application	SSz	CW	DS	SG
Rev.	Rev. Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd

Development Consent Order Drawing Number: TR010060/APP/6.3

APFP Regulation: Regulation 5(2)(a)

Client: national highways

Project: REGIONAL DELIVERY PARTNERSHIP
A12 CHELMSFORD TO A120 WIDENING SCHEME

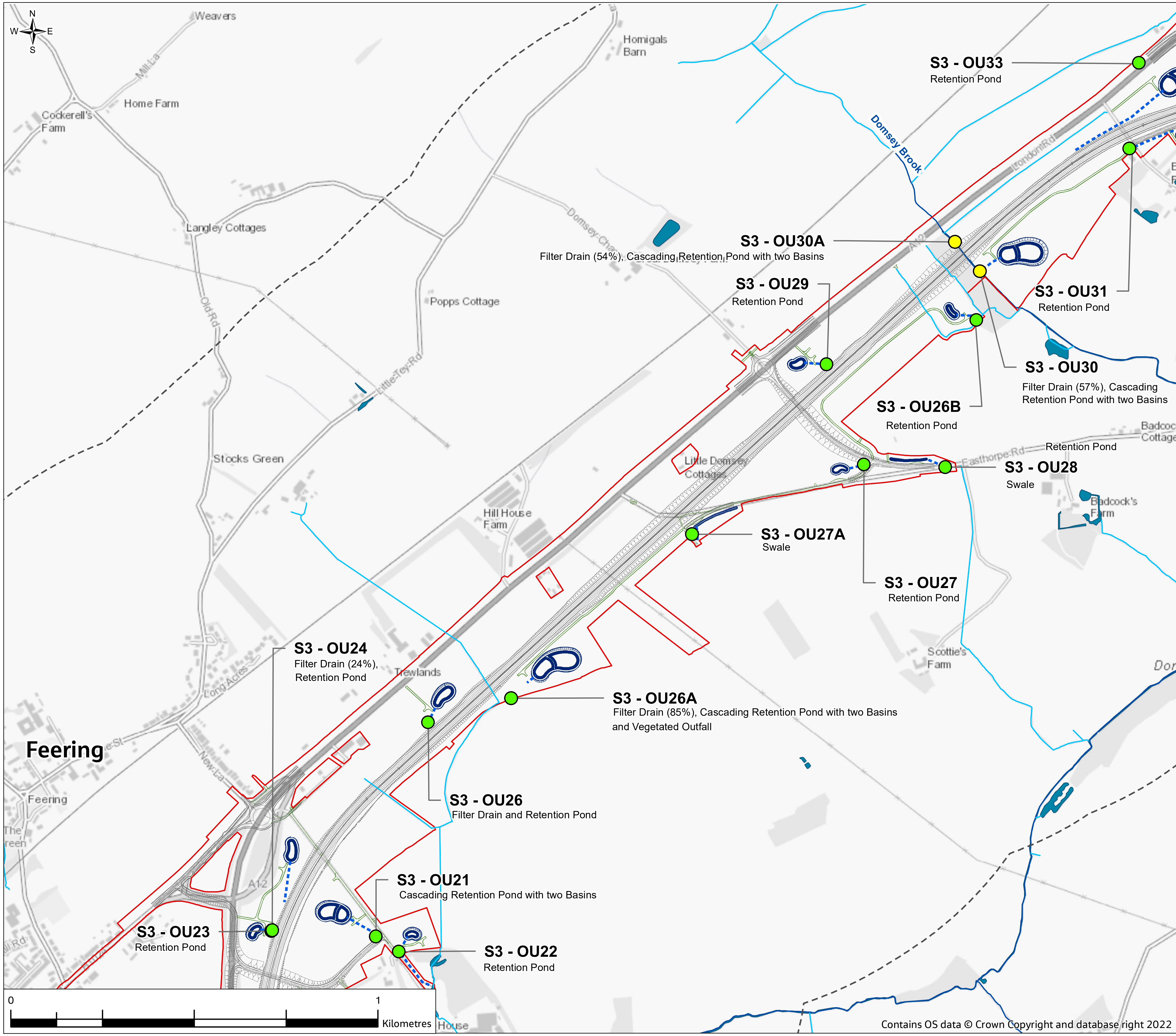
Drawing Title: WATER QUALITY ASSESSMENT REPORT
SINGLE OUTFALL ASSESSMENT RESULTS
SHEET 8 OF 11

Drawing Status: S4 - SUITABLE FOR STAGE APPROVAL

Scale @ A3	1:10000	DO NOT SCALE
Jacobs No.	B36601D1	
Client No.	HE551497	Rev P01

Drawing Number: HE551497-JAC-LDC-SCHW-SK-GI-0384

FIGURE 14.1.2



Legend

Proposed scheme
- Order Limits
- Scheme
- Study area
- Private means of access and pond access tracks
- Connection between proposed drainage pond and watercourse
- Drainage pond

Single outfall assessment results: residual effects
- Neutral
- Slight adverse

Water environment
- Main River
- Ordinary Watercourse
- Existing water features (river, ponds, lakes and reservoirs)

Note:
1. In some locations outfalls discharge to cut-off ditches, these are not currently presented.
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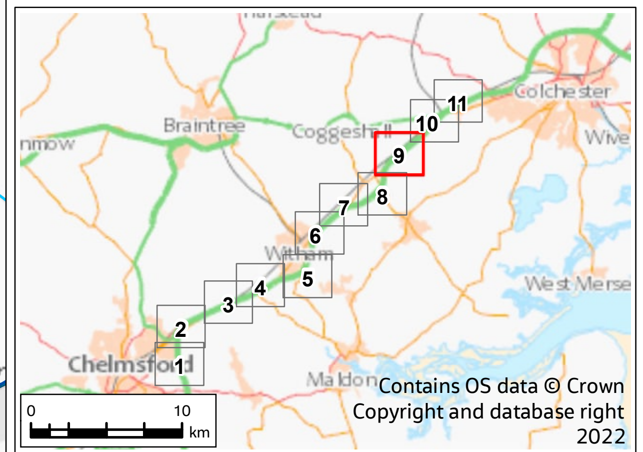
"S1" - Section 1, "S2" - Section 2, "S3" - Section 3, "IWR" - Inworth Road.



P01	04/08/22	For DCO application	SSz	CW	DS	SG
Rev.	Rev. Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd

Development Consent Order Drawing Number: TR010060/APP/6.3

APFP Regulation: Regulation 5(2)(a)

Client: national highways

Project: REGIONAL DELIVERY PARTNERSHIP A12 CHELMSFORD TO A120 WIDENING SCHEME

Drawing Title: WATER QUALITY ASSESSMENT REPORT SINGLE OUTFALL ASSESSMENT RESULTS SHEET 9 OF 11

Drawing Status: S4 - SUITABLE FOR STAGE APPROVAL

Scale @ A3	1:10000	DO NOT SCALE
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Client No.	HE551497	Rev P01

Drawing Number: HE551497-JAC-LDC-SCHW-SK-GI-0385

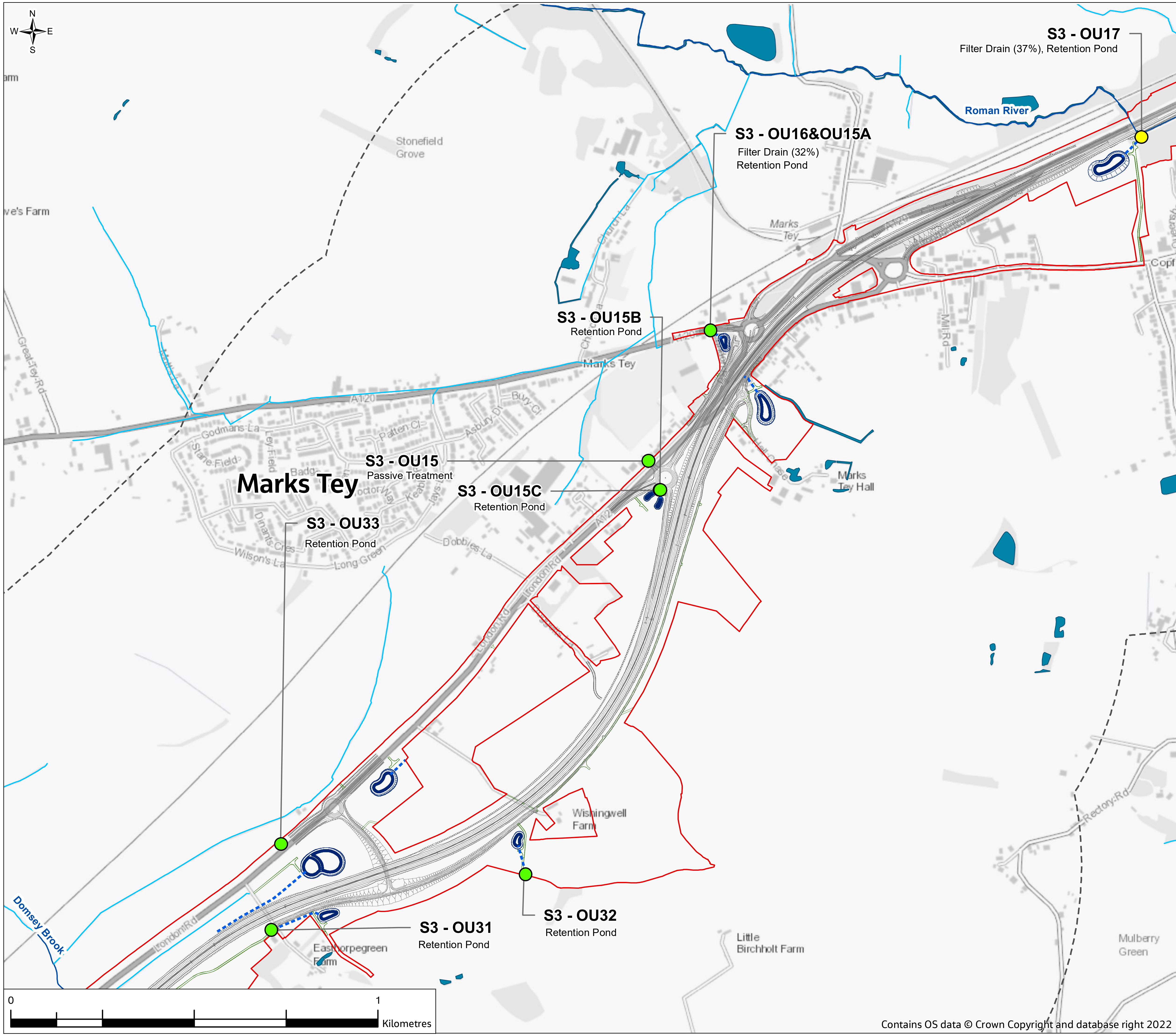


FIGURE 14.1.2

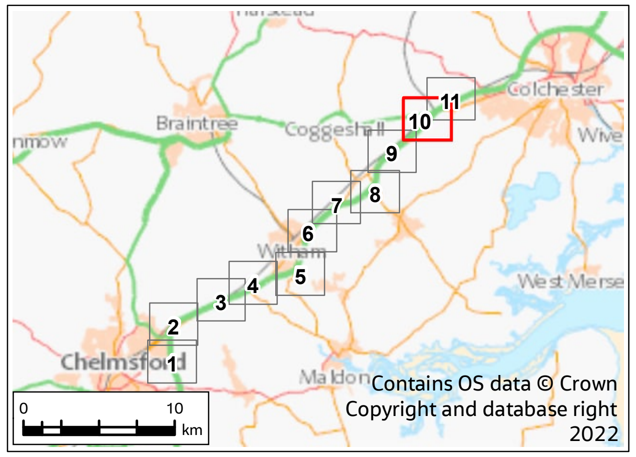
Legend

Proposed scheme
- Order Limits
- Scheme
- Study area
- Private means of access and pond access tracks
- Connection between proposed drainage pond and watercourse
- Drainage pond

Single outfall assessment results: residual effects
- Neutral
- Slight adverse

Water environment
- Main River
- Ordinary Watercourse
- Existing water features (river, ponds, lakes and reservoirs)

Note:
1. In some locations outfalls discharge to cut-off ditches, these are not currently presented.
2. Abbreviation meaning:
"S1" - Section 1, "S2" - Section 2, "S3" - Section 3, "IWR" - Inworth Road.



Rev.	Rev. Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd
P01	04/08/22	For DCO application	SSz	CW	DS	SG

Development Consent Order Drawing Number: TR010060/APP/6.3

APFP Regulation: Regulation 5(2)(a)

Client: national highways

Project: REGIONAL DELIVERY PARTNERSHIP
A12 CHELMSFORD TO A120 WIDENING SCHEME

Drawing Title: WATER QUALITY ASSESSMENT REPORT
SINGLE OUTFALL ASSESSMENT RESULTS
SHEET 10 OF 11

Drawing Status: S4 - SUITABLE FOR STAGE APPROVAL

Scale @ A3	1:10000	DO NOT SCALE	
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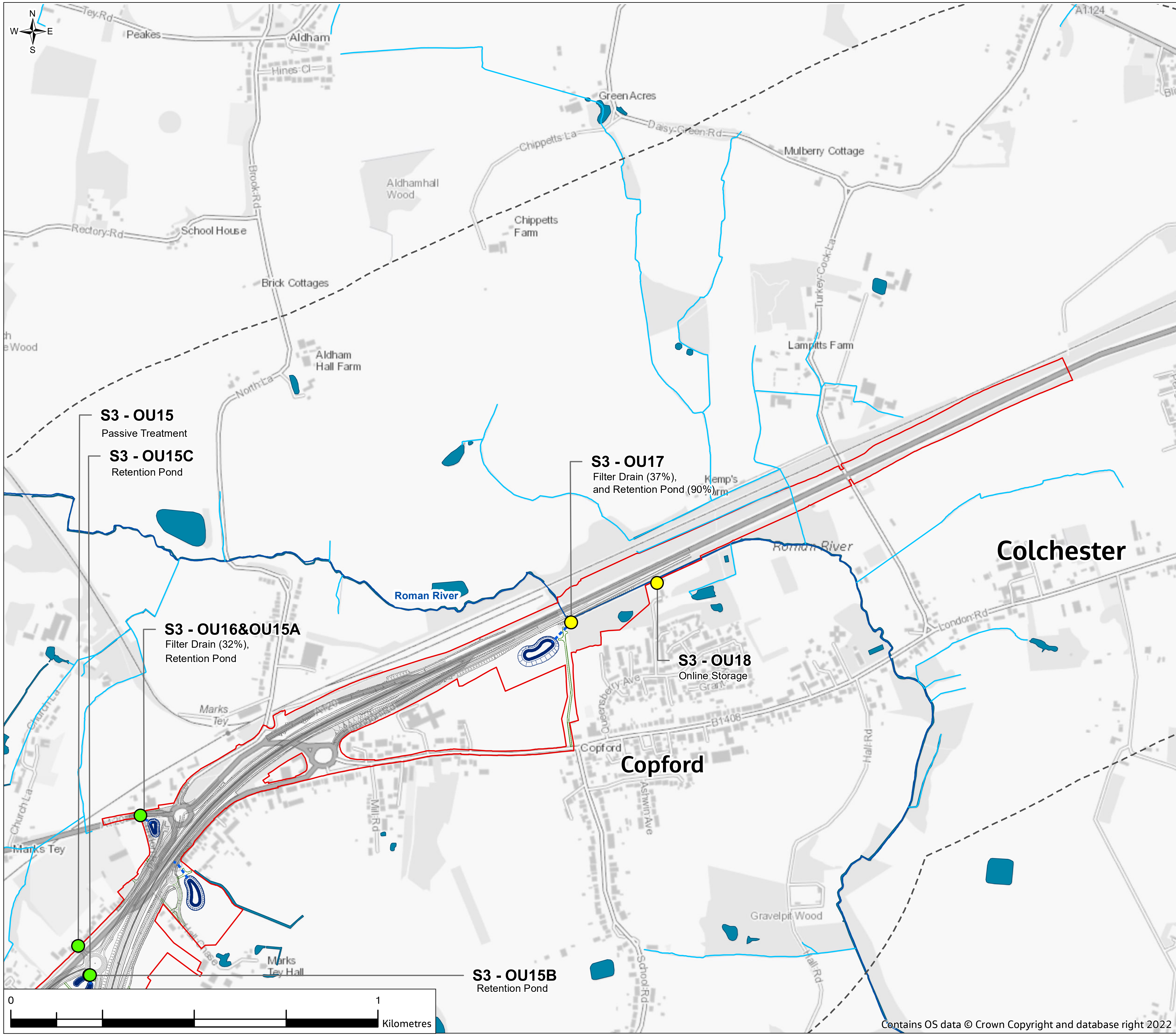
Client No.	HE551497	Rev	P01

Drawing Number: HE551497-JAC-LDC-SCHW-SK-GI-0386

FIGURE 14.1.2



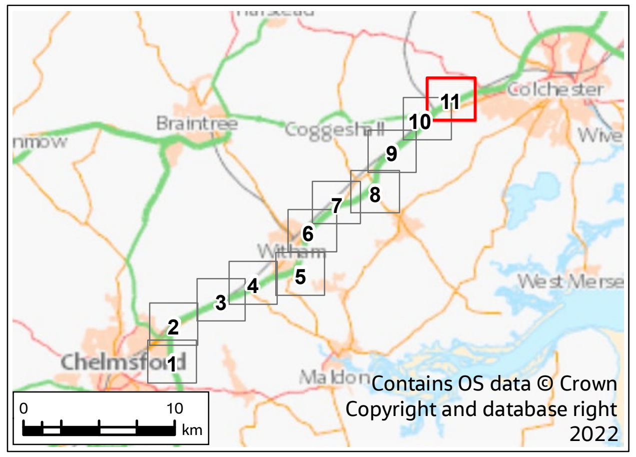
Legend

Proposed scheme
- Order Limits
- Scheme
- Study area
- Private means of access and pond access tracks
- Connection between proposed drainage pond and watercourse
- Drainage pond

Single outfall assessment results: residual effects
- Neutral
- Slight adverse

Water environment
- Main River
- Ordinary Watercourse
- Existing water features (river, ponds, lakes and reservoirs)

Note:
1. In some locations outfalls discharge to cut-off ditches, these are not currently presented.
2. Abbreviation meaning:
"S1" - Section 1, "S2" - Section 2, "S3" - Section 3, "IWR" - Inworth Road.



P01	04/08/22	For DCO application	SSz	CW	DS	SG
Rev.	Rev. Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd

Development Consent Order Drawing Number: TR010060/APP/6.3

APFP Regulation: Regulation 5(2)(a)

Client: national highways

Project: REGIONAL DELIVERY PARTNERSHIP
A12 CHELMSFORD TO A120 WIDENING SCHEME

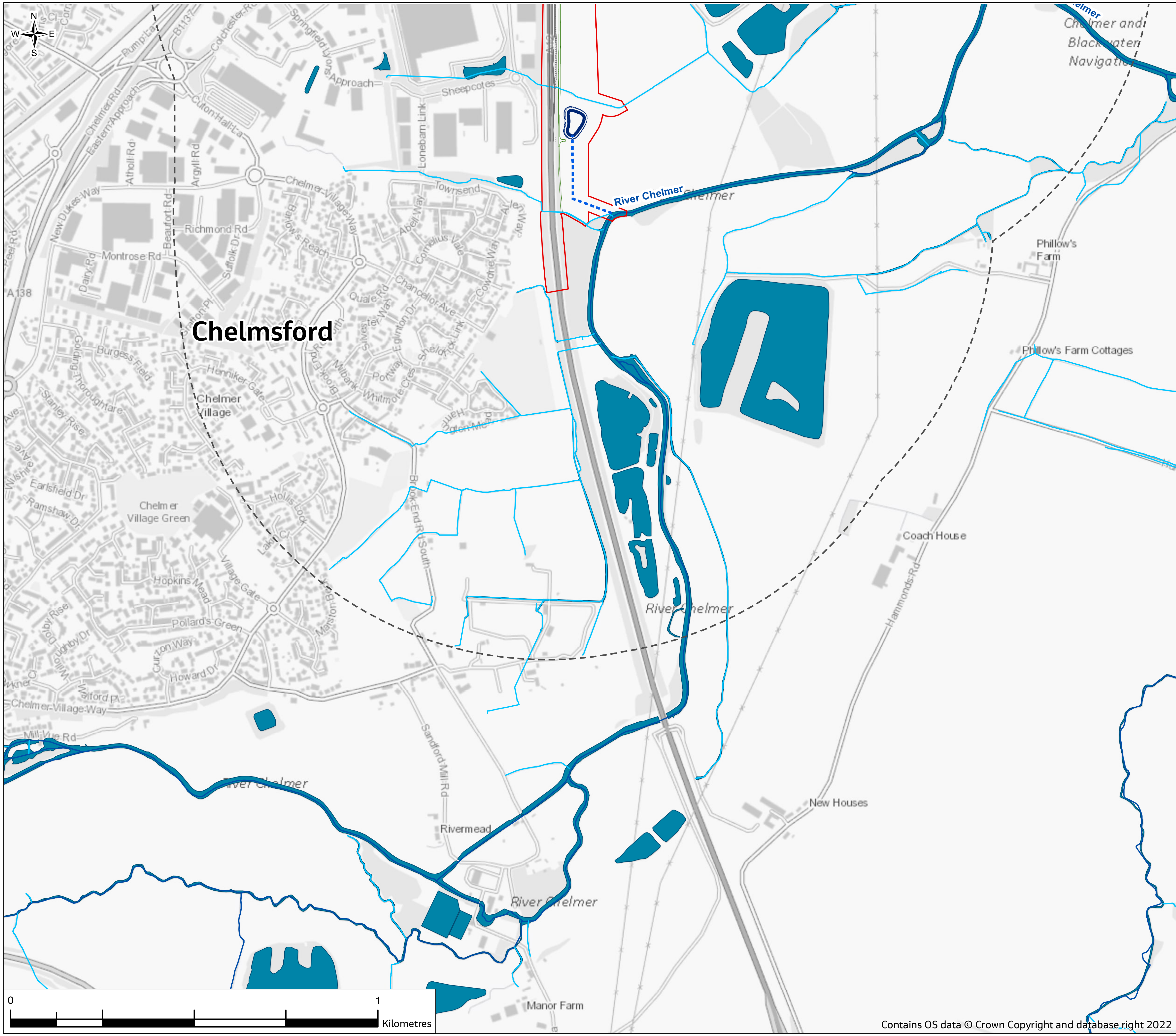
Drawing Title: WATER QUALITY ASSESSMENT REPORT
SINGLE OUTFALL ASSESSMENT RESULTS
SHEET 11 OF 11

Drawing Status: S4 - SUITABLE FOR STAGE APPROVAL

Scale @ A3	1:10000	DO NOT SCALE
Jacobs No.	B36601D1	
Client No.	HE551497	Rev P01

Drawing Number: HE551497-JAC-LDC-SCHW-SK-GI-0387

FIGURE 14.1.3

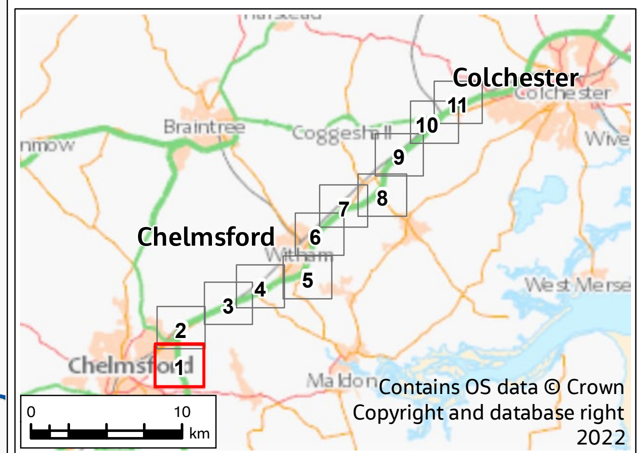


Legend

Proposed scheme
- Order Limits
- Scheme
- Study area
- Connection between proposed drainage pond and watercourse
- Private means of access and pond access tracks

Water environment
- Main River
- Ordinary Watercourse
- Drainage pond
- Existing water features (river, ponds, lakes and reservoirs)

Note:
1. Only those outfalls included in a cumulative assessment are shown.



P01	04/08/22	For DCO application	SSz	CW	DS	SG
Rev.	Rev. Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd

Development Consent Order Drawing Number: TR010060/APP/6.3

APFP Regulation: Regulation 5(2)(a)

Client

national highways

Project

REGIONAL DELIVERY PARTNERSHIP
A12 CHELMSFORD TO A120 WIDENING SCHEME

Drawing Title

WATER QUALITY ASSESSMENT REPORT
CUMULATIVE OUTFALL ASSESSMENT RESULTS
SHEET 1 OF 11

Drawing Status: S4 - SUITABLE FOR STAGE APPROVAL

Scale @ A3	1:10000	DO NOT SCALE
Jacobs No.	B36601D1	
Client No.	HE551497	Rev P01

Drawing Number: HE551497-JAC-LDC-SCHW-SK-GI-0388

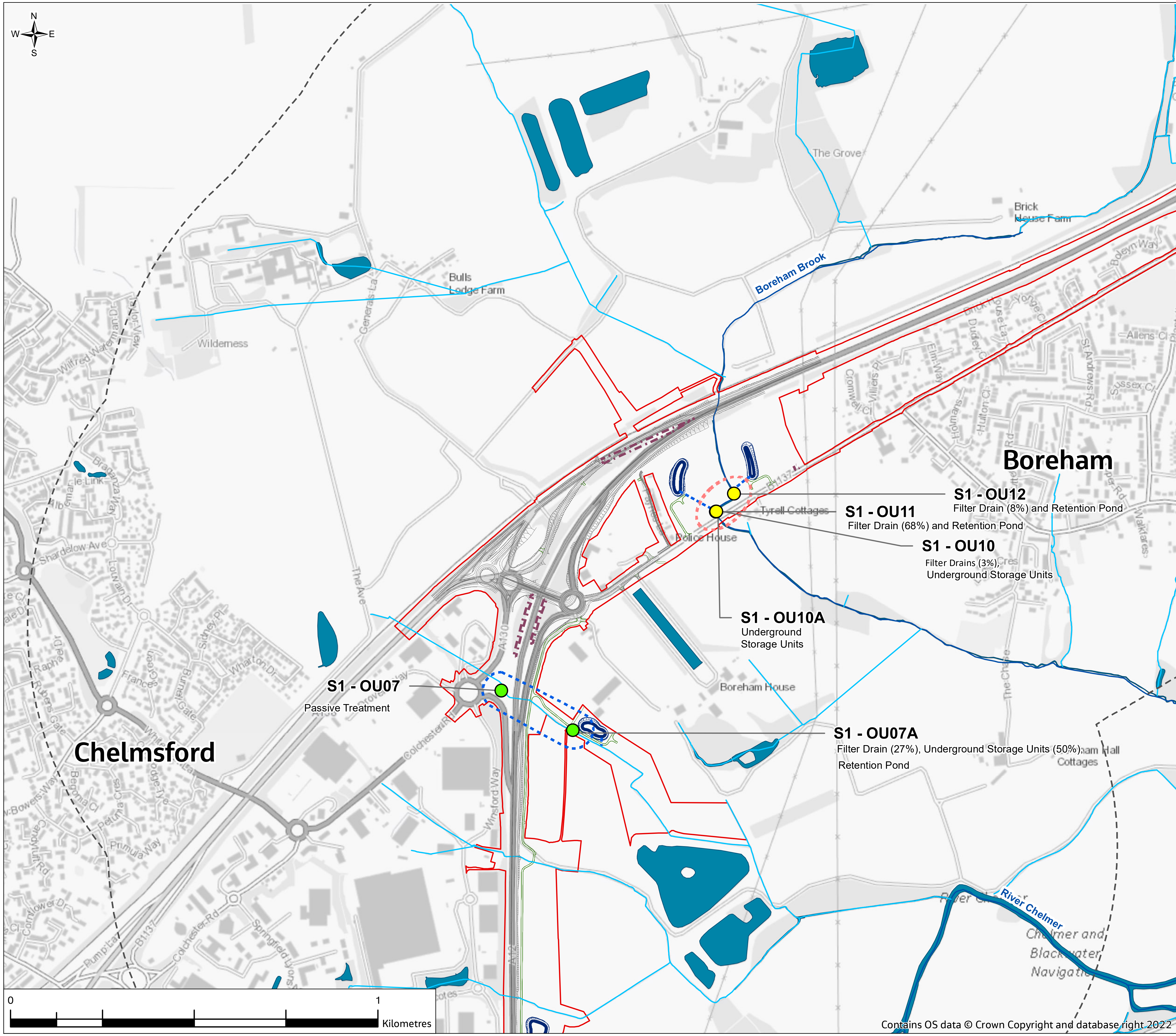


FIGURE 14.1.3

Legend

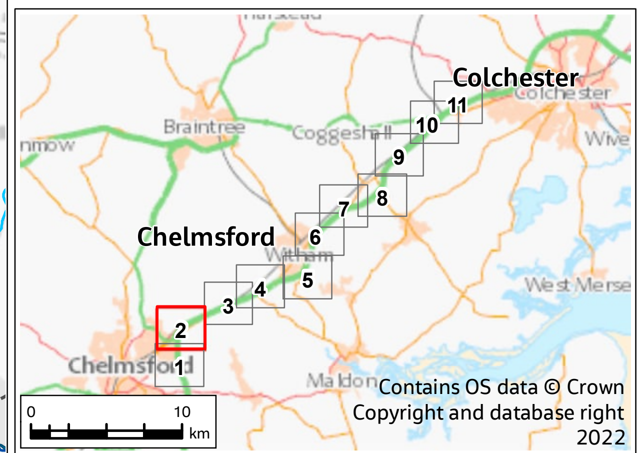
Proposed scheme
- Order Limits
- Scheme
- Study area
- Connection between proposed drainage pond and watercourse
- Temporary roads
- Private means of access and pond access tracks

Cumulative outfall assessment area
- Boreham Brook
- Ordinary Watercourse 2

Water environment
- Main River
- Ordinary Watercourse
- Drainage pond
- Existing water features (river, ponds, lakes and reservoirs)

Cumulative outfall assessment results: residual effects
- Slight adverse
- Neutral

Note:
1. Only those outfalls included in a cumulative assessment are shown.



P01	04/08/22	For DCO application	SSz	CW	DS	SG
Rev.	Rev. Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd

Development Consent Order Drawing Number: TR010060/APP/6.3

APFP Regulation: Regulation 5(2)(a)

Client: national highways

Project: REGIONAL DELIVERY PARTNERSHIP
A12 CHELMSFORD TO A120 WIDENING SCHEME

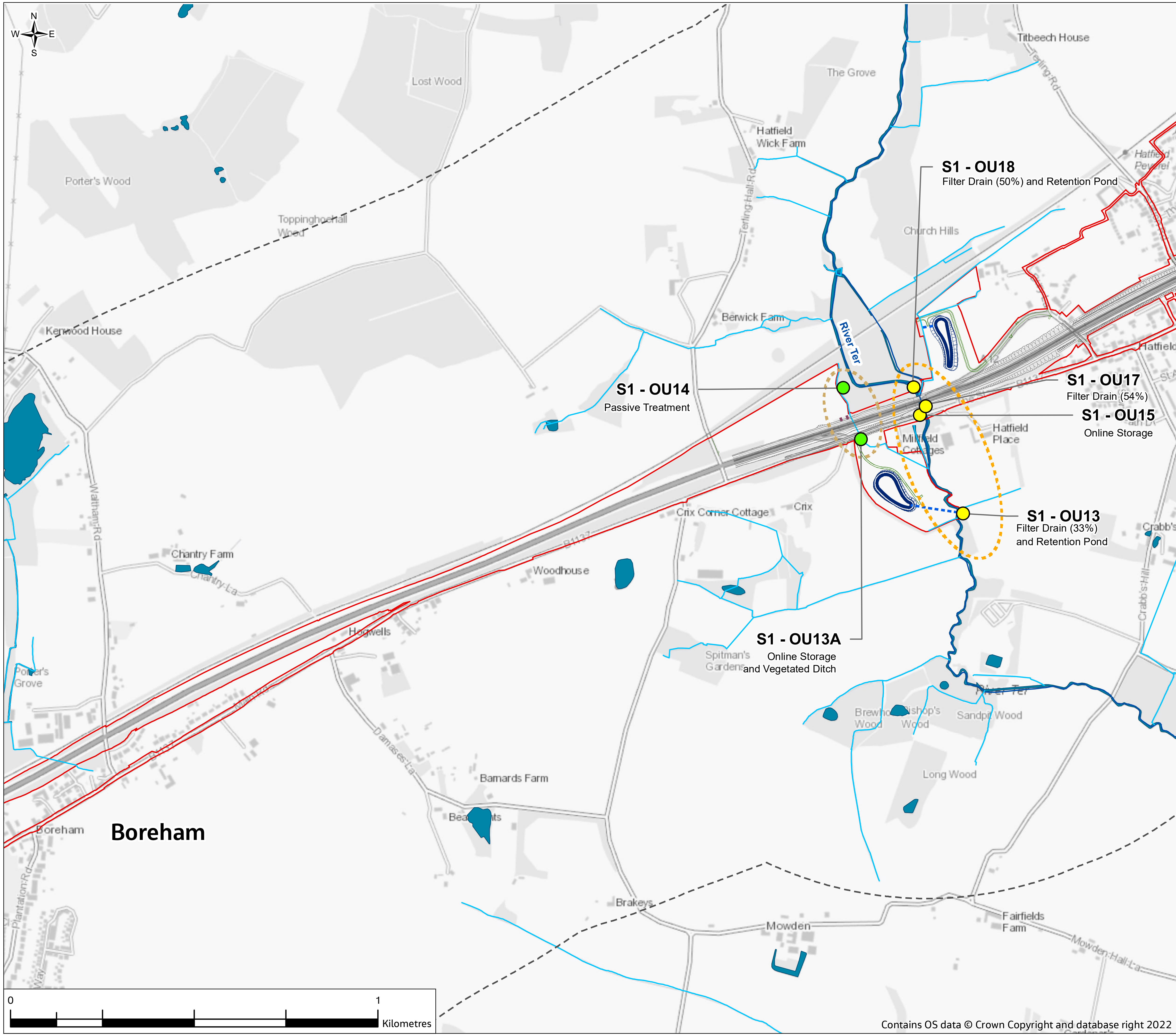
Drawing Title: WATER QUALITY ASSESSMENT REPORT
CUMULATIVE OUTFALL ASSESSMENT RESULTS
SHEET 2 OF 11

Drawing Status: S4 - SUITABLE FOR STAGE APPROVAL

Scale @ A3	1:10000	DO NOT SCALE
Jacobs No.	B36601D1	
Client No.	HE551497	Rev P01

Drawing Number: HE551497-JAC-LDC-SCHW-SK-GI-0389

FIGURE 14.1.3



Legend

Proposed scheme

- Order Limits
- Scheme
- Study area
- Connection between proposed drainage pond and watercourse
- Temporary roads
- Private means of access and pond access tracks

Cumulative outfall assessment area

- Ordinary Watercourse 28
- River Ter

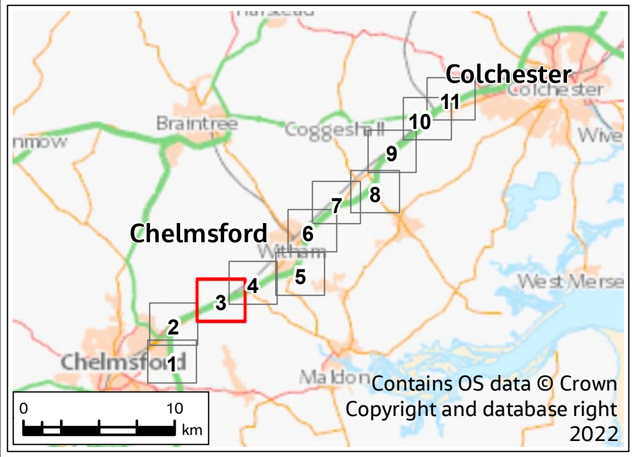
Water environment

- Main River
- Ordinary Watercourse
- Drainage pond
- Existing water features (river, ponds, lakes and reservoirs)

Cumulative outfall assessment results: residual effects

- Slight adverse
- Neutral

Note:
1. Only those outfalls included in a cumulative assessment are shown.



Rev.	Rev. Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd
P01	04/08/22	For DCO application	SSz	CW	DS	SG

Development Consent Order Drawing Number: TR010060/APP/6.3

APFP Regulation: Regulation 5(2)(a)

Client

national highways

Project

REGIONAL DELIVERY PARTNERSHIP
A12 CHELMSFORD TO A120 WIDENING SCHEME

Drawing Title

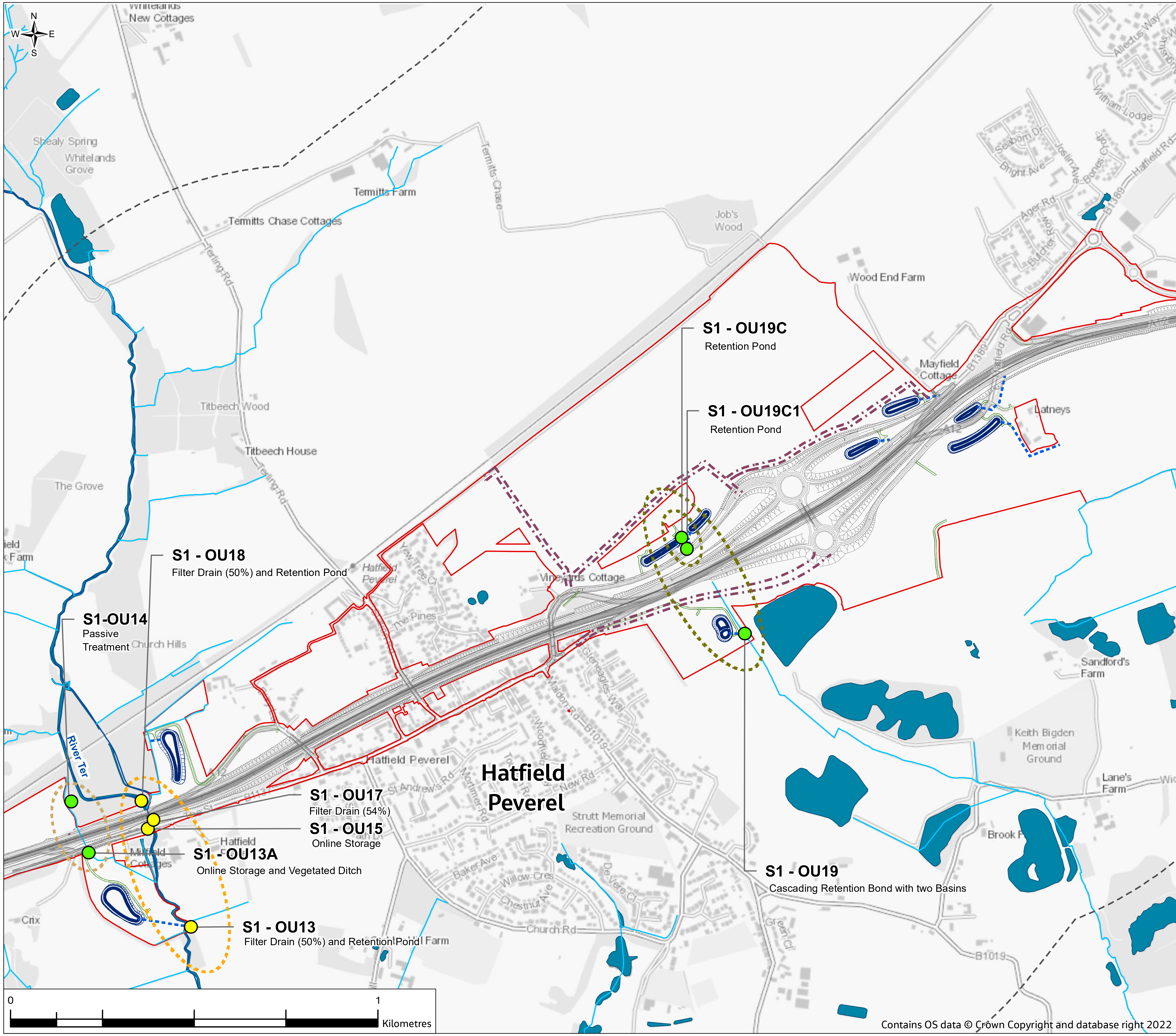
WATER QUALITY ASSESSMENT REPORT
CUMULATIVE OUTFALL ASSESSMENT RESULTS
SHEET 3 OF 11

Drawing Status: S4 - SUITABLE FOR STAGE APPROVAL

Scale @ A3	1:10000	DO NOT SCALE
Jacobs No.	B36601D1	
Client No.	HE551497	Rev P01

Drawing Number: HE551497-JAC-LDC-SCHW-SK-GI-0390

FIGURE 14.1.3



Legend

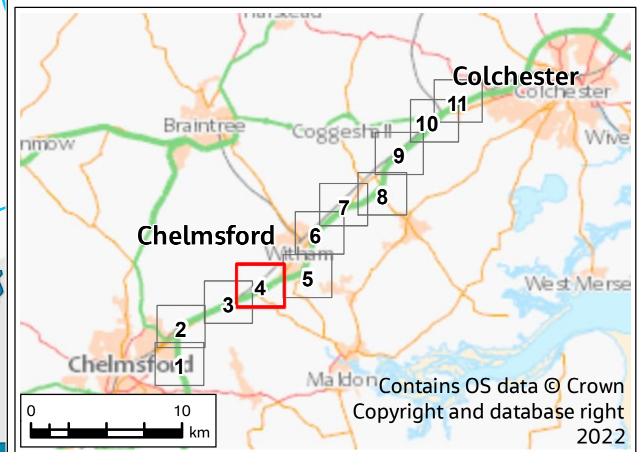
Proposed scheme
- Order Limits
- Scheme
- Study area
- Connection between proposed drainage pond and watercourse
- Temporary roads
- Private means of access and pond access tracks

Cumulative outfall assessment area
- Ordinary Watercourse 28
- Ordinary Watercourse 7
- River Ter

Water environment
- Main River
- Ordinary Watercourse
- Drainage pond
- Existing water features (river, ponds, lakes and reservoirs)

Cumulative outfall assessment results: residual effects
- Slight adverse
- Neutral

Note:
1. Only those outfalls included in a cumulative assessment are shown.



Rev.	Rev. Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd
P01	04/08/22	For DCO application	SSz	CW	DS	SG

Development Consent Order Drawing Number: TR010060/APP/6.3

APFP Regulation: Regulation 5(2)(a)

Client: national highways

Project: REGIONAL DELIVERY PARTNERSHIP
A12 CHELMSFORD TO A120 WIDENING SCHEME

Drawing Title: WATER QUALITY ASSESSMENT REPORT
CUMULATIVE OUTFALL ASSESSMENT RESULTS
SHEET 4 OF 11

Drawing Status: S4 - SUITABLE FOR STAGE APPROVAL

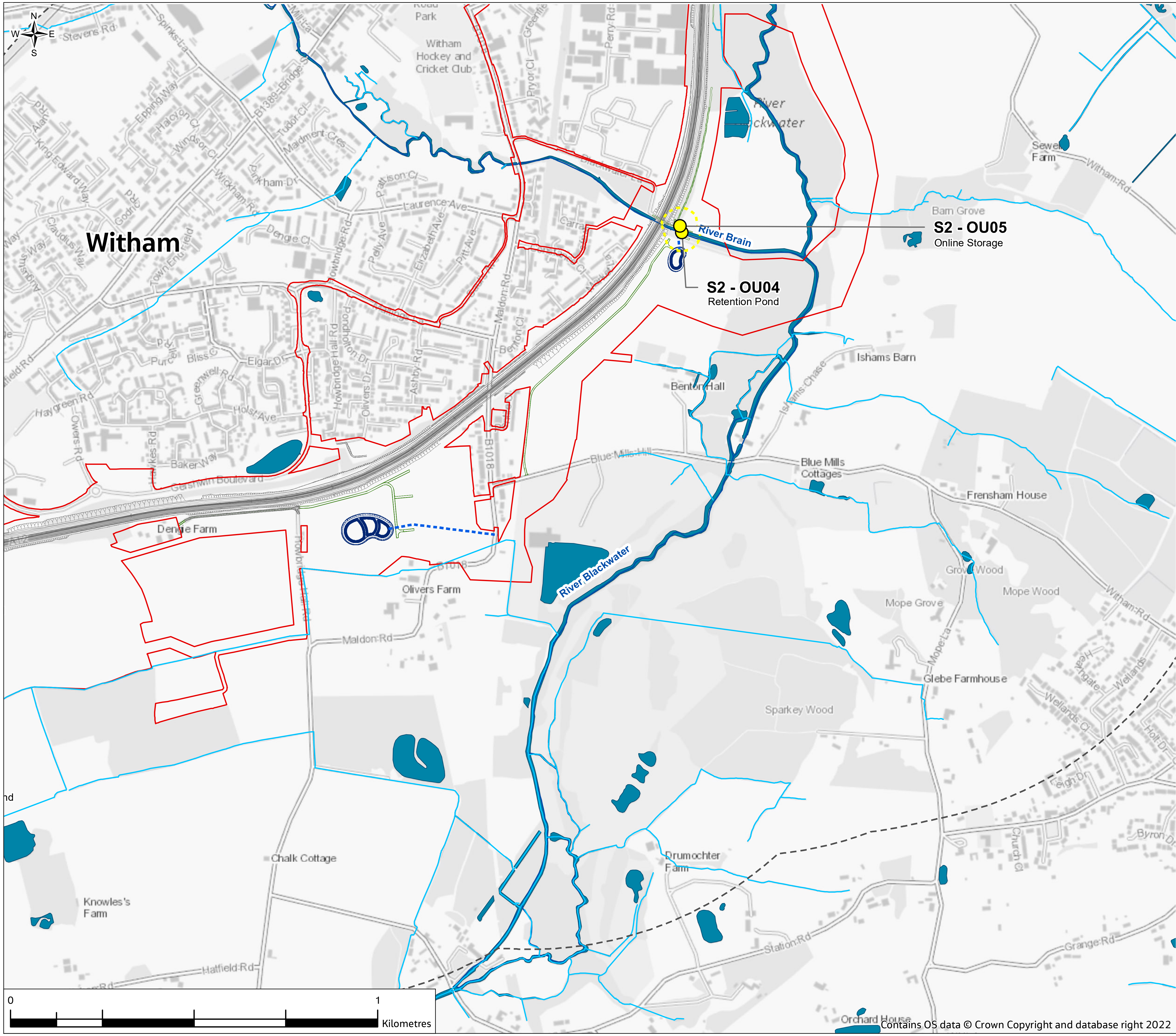
Scale @ A3	1:10000
Jacobs No.	B36601D1
Client No.	HE551497

DO NOT SCALE

Rev P01

Drawing Number: HE551497-JAC-LDC-SCHW-SK-GI-0391

FIGURE 14.1.3



Legend

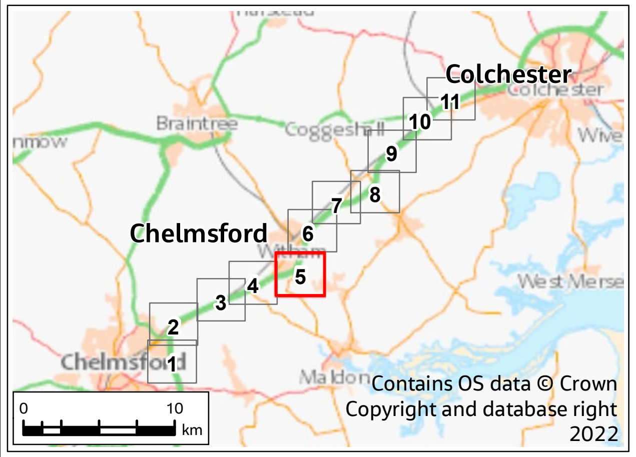
Proposed scheme
- Order Limits
- Scheme
- Study area
- Connection between proposed drainage pond and watercourse
- Private means of access and pond access tracks

Cumulative outfall assessment area
- River Brain

Water environment
- Main River
- Ordinary Watercourse
- Drainage pond
- Existing water features (river, ponds, lakes and reservoirs)

Cumulative outfall assessment results: residual effects
- Slight adverse

Note:
1. Only those outfalls included in a cumulative assessment are shown.



P01	04/08/22	For DCO application	SSz	CW	DS	SG
Rev.	Rev. Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd

Development Consent Order Drawing Number: TR010060/APP/6.3

APFP Regulation: Regulation 5(2)(a)

Client: national highways

Project: REGIONAL DELIVERY PARTNERSHIP
A12 CHELMSFORD TO A120 WIDENING SCHEME

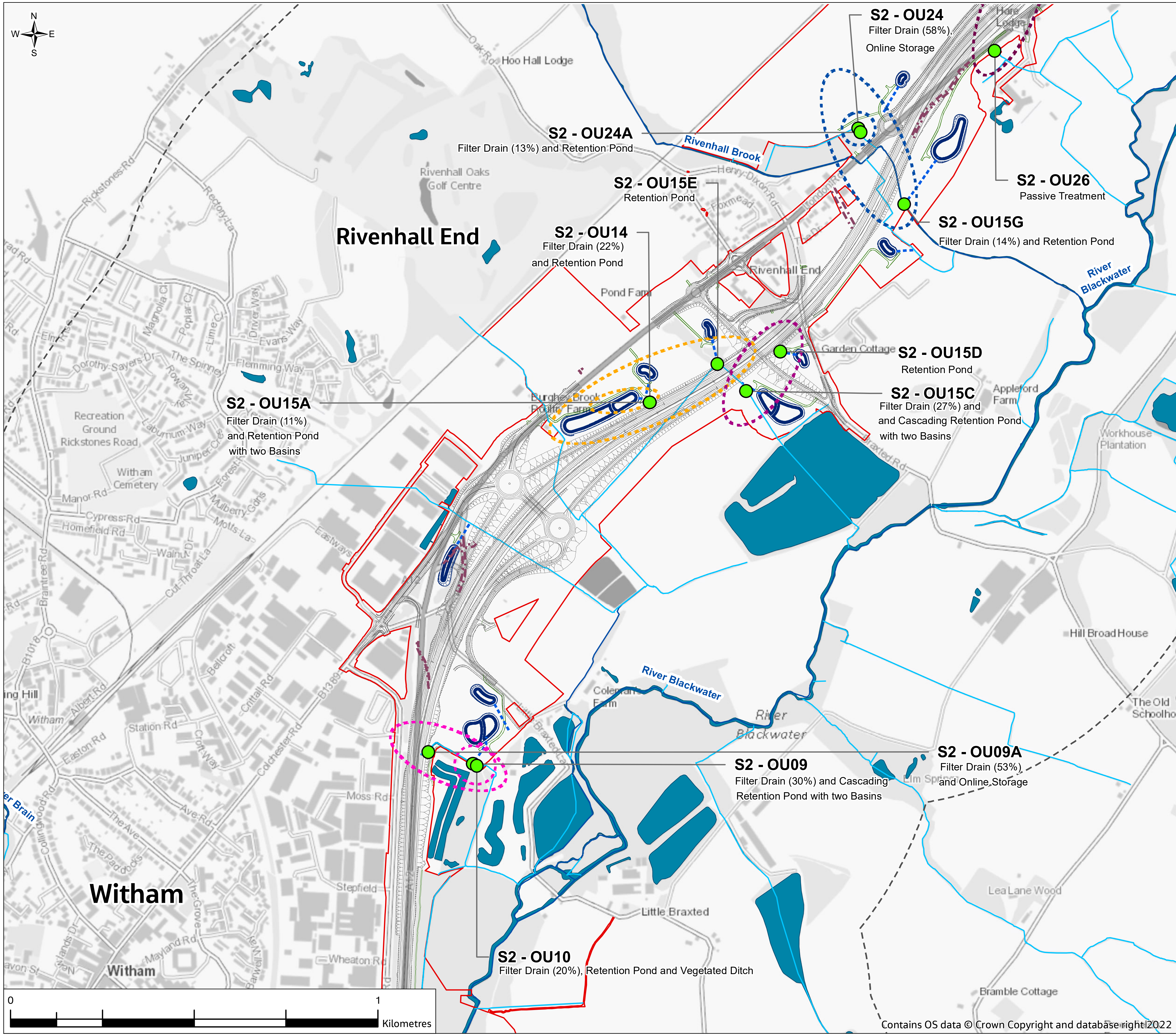
Drawing Title: WATER QUALITY ASSESSMENT REPORT
CUMULATIVE OUTFALL ASSESSMENT RESULTS
SHEET 5 OF 11

Drawing Status: S4 - SUITABLE FOR STAGE APPROVAL

Scale @ A3	1:10000	DO NOT SCALE
Jacobs No.	B36601D1	
Client No.	HE551497	Rev P01

Drawing Number: HE551497-JAC-LDC-SCHW-SK-GI-0392

FIGURE 14.1.3



Legend

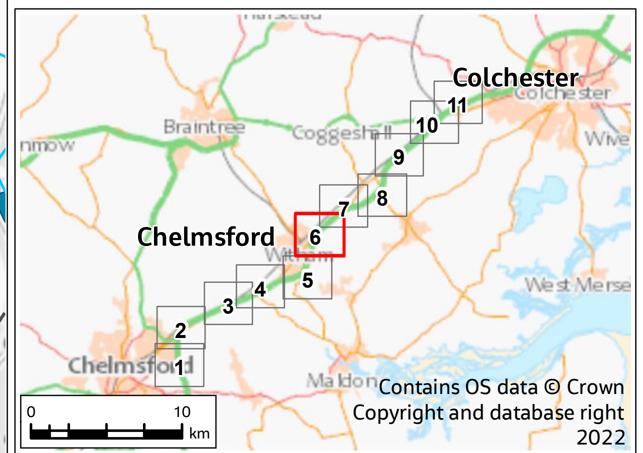
Proposed scheme
- Order Limits
- Scheme
- Study area
- Connection between proposed drainage pond and watercourse
- Temporary roads
- Private means of access and pond access tracks

Cumulative outfall assessment area
- Ordinary Watercourse 10
- Ordinary Watercourse 12
- Ordinary Watercourse 13
- Ordinary Watercourse 17
- Rivenhall Brook

Water environment
- Main River
- Ordinary Watercourse
- Drainage pond
- Existing water features (river, ponds, lakes and reservoirs)

Cumulative outfall assessment results: residual effects
- Neutral

Note:
1. Only those outfalls included in a cumulative assessment are shown.



P01	04/08/22	For DCO application	SSz	CW	DS	SG
Rev.	Rev. Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd

Development Consent Order Drawing Number: TR010060/APP/6.3

APFP Regulation: Regulation 5(2)(a)

Client: national highways

Project: REGIONAL DELIVERY PARTNERSHIP
A12 CHELMSFORD TO A120 WIDENING SCHEME

Drawing Title: WATER QUALITY ASSESSMENT REPORT
CUMULATIVE OUTFALL ASSESSMENT RESULTS
SHEET 6 OF 11

Drawing Status: S4 - SUITABLE FOR STAGE APPROVAL

Scale @ A3	1:10000	DO NOT SCALE
Jacobs No.	B36601D1	
Client No.	HE551497	Rev P01

Drawing Number: HE551497-JAC-LDC-SCHW-SK-GI-0393

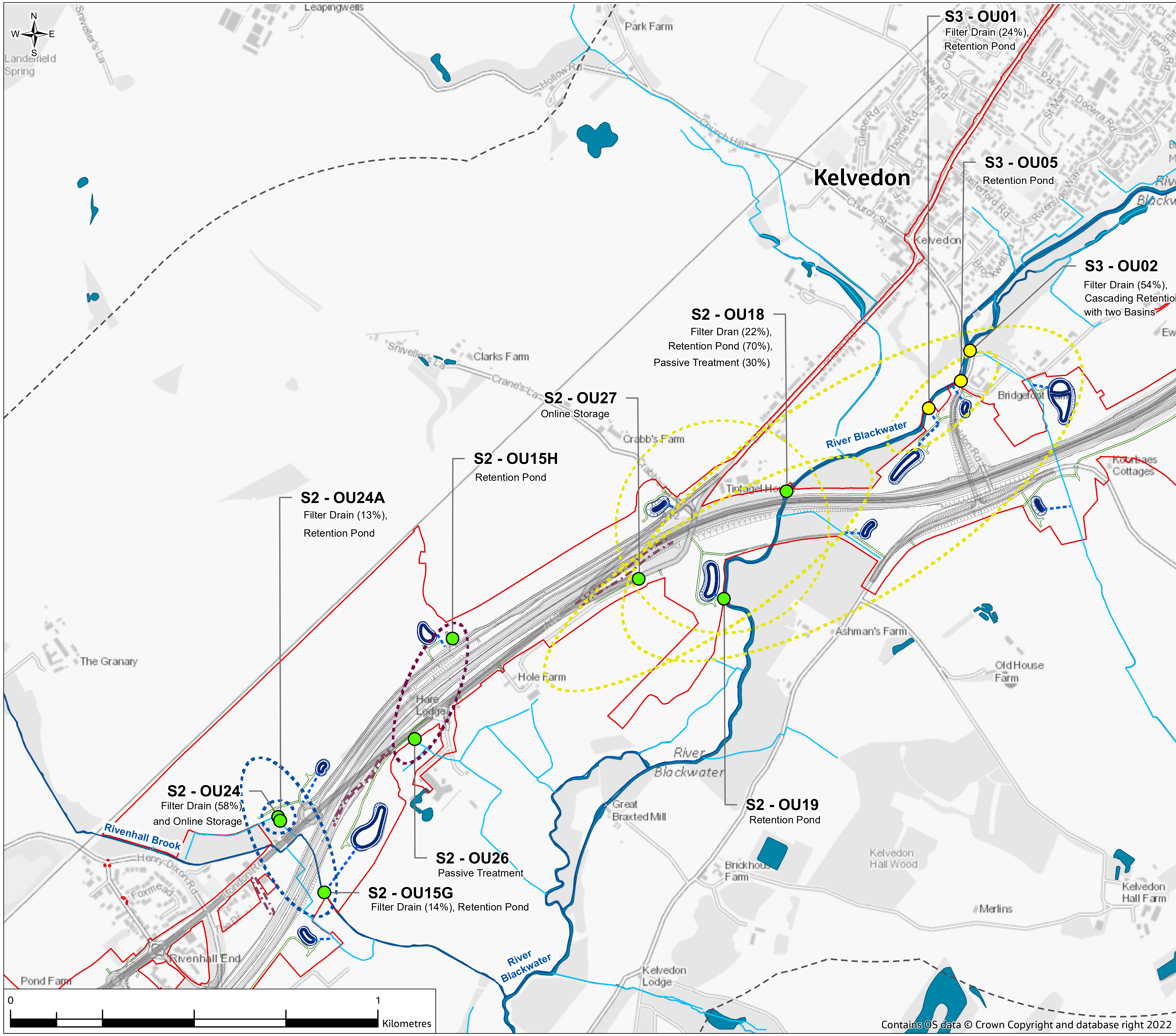


FIGURE 14.1.3

Legend

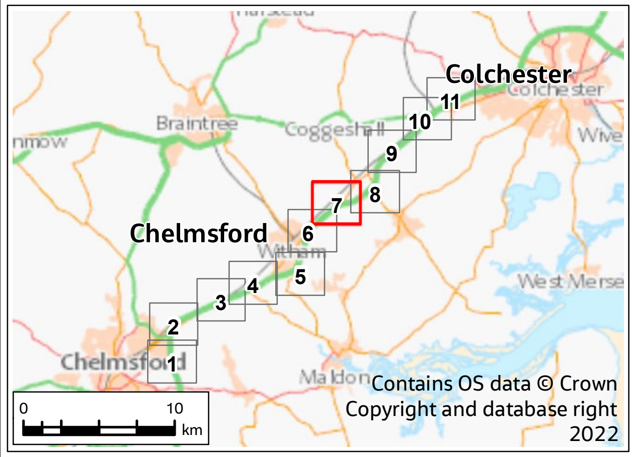
Proposed scheme
- Order Limits
- Scheme
- Study area
- Connection between proposed drainage pond and watercourse
- Temporary roads
- Private means of access and pond access tracks

Cumulative outfall assessment area
- Ordinary Watercourse 12
- Ordinary Watercourse 13
- Ordinary Watercourse 17
- Rivenhall Brook
- River Blackwater

Water environment
- Main River
- Ordinary Watercourse
- Drainage pond
- Existing water features (river, ponds, lakes and reservoirs)

Cumulative outfall assessment results: residual effects
- Slight adverse
- Neutral

Note:
1. Only those outfalls included in a cumulative assessment are shown.



P01	04/08/22	For DCO application	SSz	CW	DS	SG
Rev.	Rev. Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd

Development Consent Order Drawing Number: TR010060/APP/6.3

APFP Regulation: Regulation 5(2)(a)

Client

national highways

Project

REGIONAL DELIVERY PARTNERSHIP
A12 CHELMSFORD TO A120 WIDENING SCHEME

Drawing Title

WATER QUALITY ASSESSMENT REPORT
CUMULATIVE OUTFALL ASSESSMENT RESULTS
SHEET 7 OF 11

Drawing Status: S4 - SUITABLE FOR STAGE APPROVAL

Scale @ A3	1:10000	DO NOT SCALE
Jacobs No.	B36601D1	
Client No.	HE551497	Rev P01

Drawing Number: HE551497-JAC-LDC-SCHW-SK-GI-0394

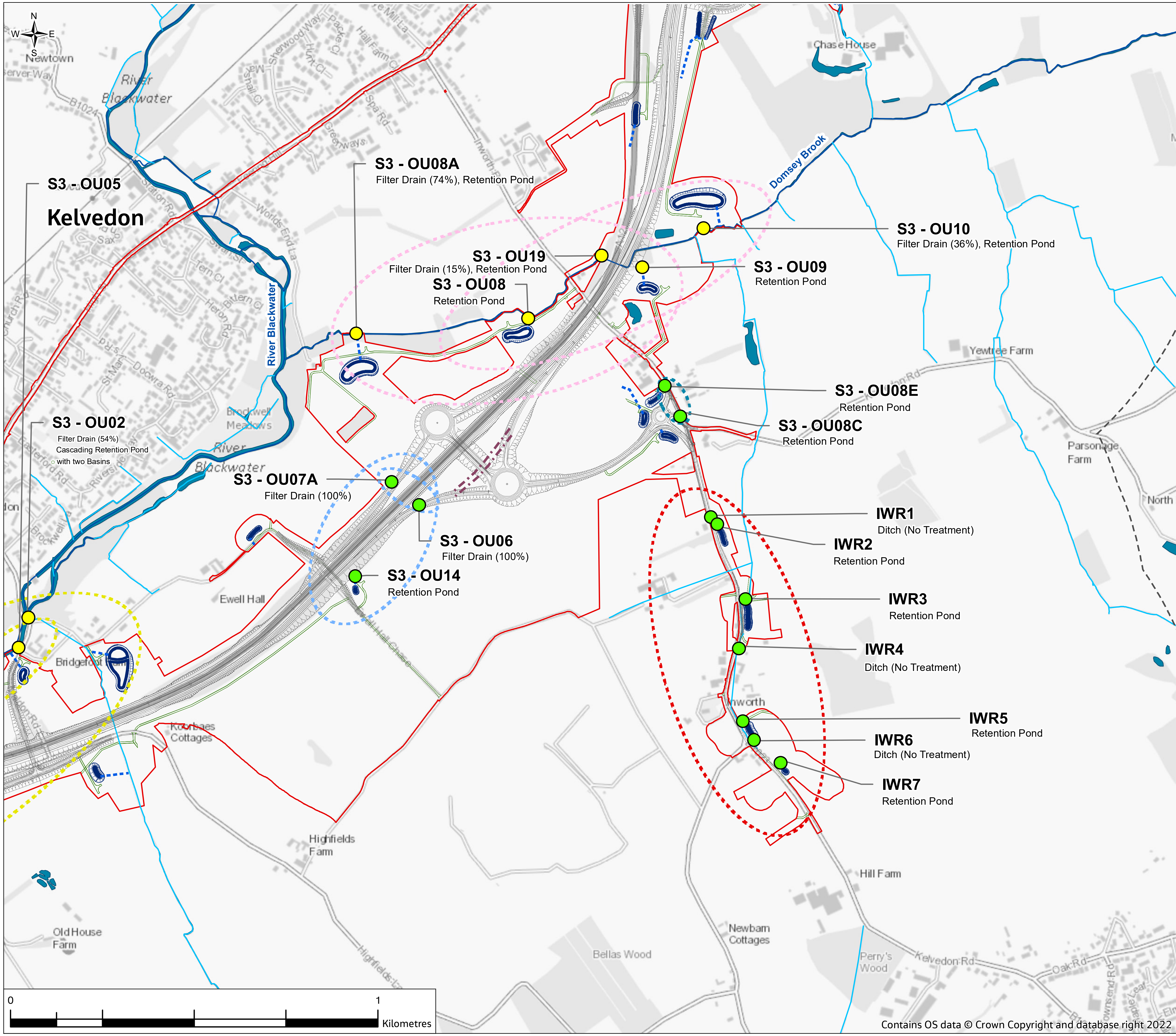


FIGURE 14.1.3

Legend

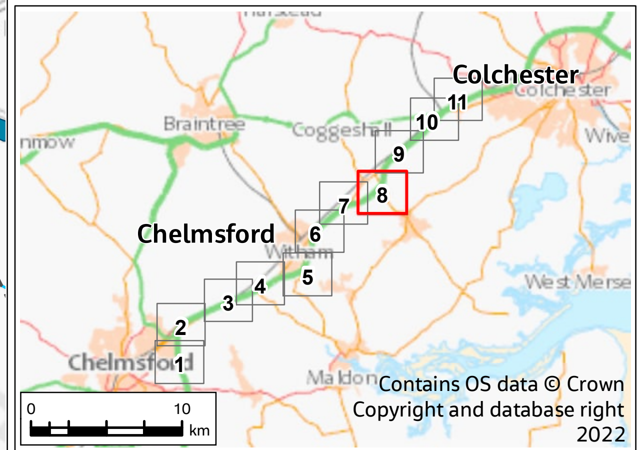
Proposed scheme
- Order Limits
- Scheme
- Study area
- Connection between proposed drainage pond and watercourse
- Temporary roads
- Private means of access and pond access tracks

Cumulative outfall assessment area
- Domsey Brook d/s
- Existing Drainage Inworth Road
- Ordinary Watercourse 21a
- Ordinary Watercourse 34
- River Blackwater

Water environment
- Main River
- Ordinary Watercourse
- Drainage pond
- Existing water features (river, ponds, lakes and reservoirs)

Cumulative outfall assessment results: residual effects
- Slight adverse
- Neutral

Note:
1. Only those outfalls included in a cumulative assessment are shown.



Rev.	Rev. Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd
P01	04/08/22	For DCO application	SSz	CW	DS	SG

Development Consent Order Drawing Number: TR010060/APP/6.3

APFP Regulation: Regulation 5(2)(a)

Client: national highways

Project: REGIONAL DELIVERY PARTNERSHIP
A12 CHELMSFORD TO A120 WIDENING SCHEME

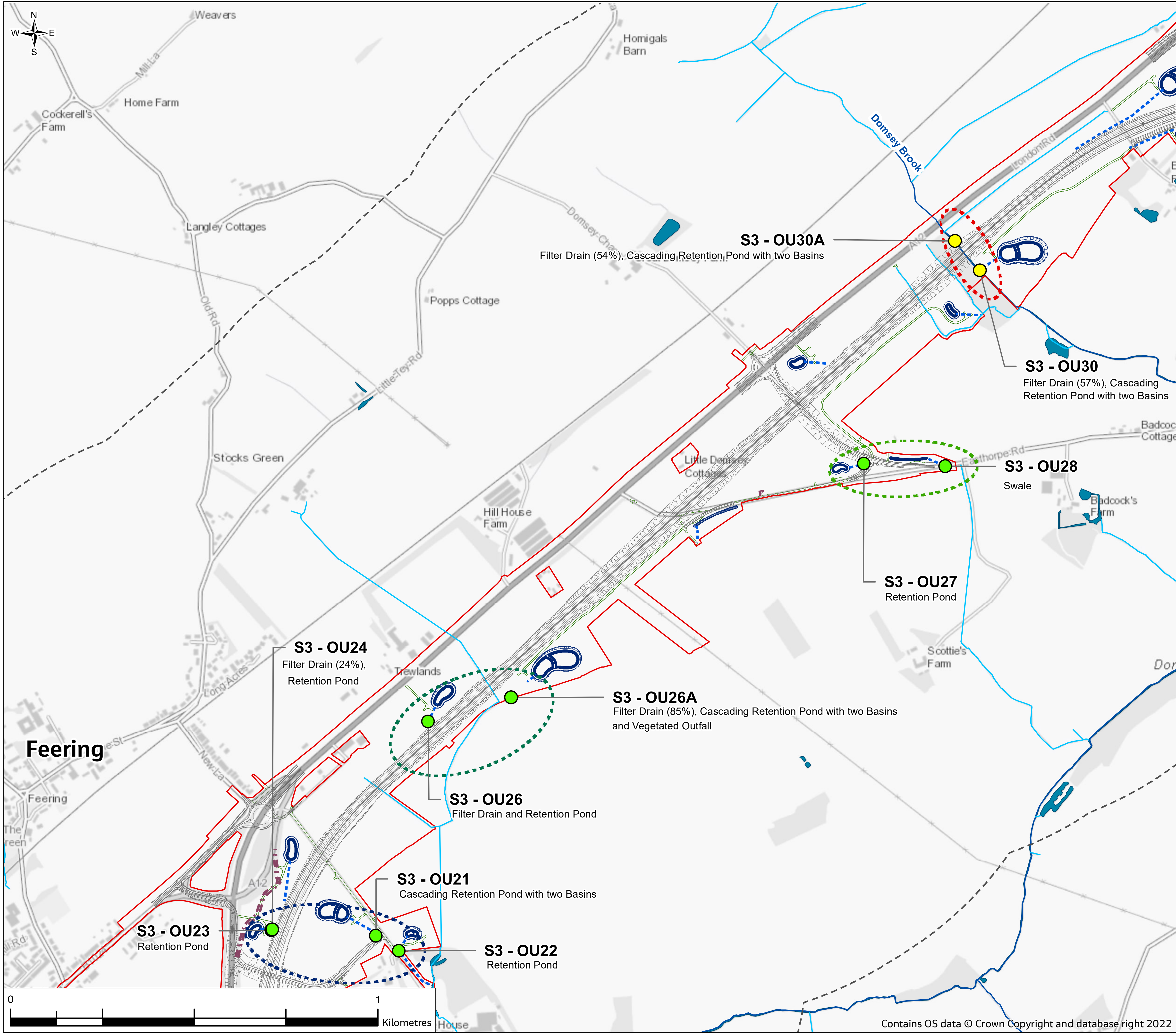
Drawing Title: WATER QUALITY ASSESSMENT REPORT
CUMULATIVE OUTFALL ASSESSMENT RESULTS
SHEET 8 OF 11

Drawing Status: S4 - SUITABLE FOR STAGE APPROVAL

Scale @ A3	1:10000	DO NOT SCALE
Jacobs No.	B36601D1	
Client No.	HE551497	Rev P01

Drawing Number: HE551497-JAC-LDC-SCHW-SK-GI-0395

FIGURE 14.1.3



Legend

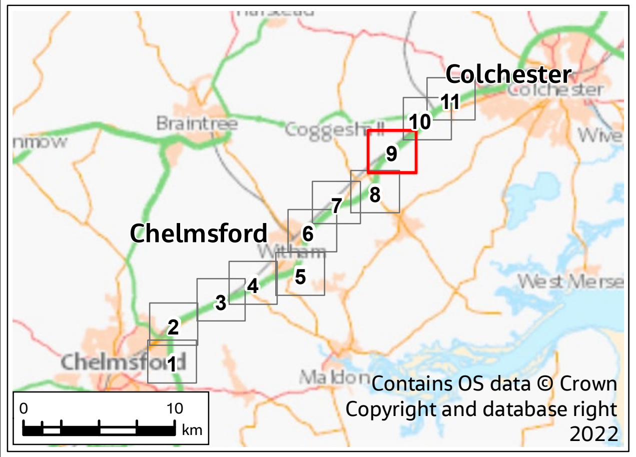
Proposed scheme
- Order Limits
- Scheme
- Study area
- Connection between proposed drainage pond and watercourse
- Temporary roads
- Private means of access and pond access tracks

Cumulative outfall assessment area
- Domsey Brook u/s
- Ordinary Watercourse 23
- Ordinary Watercourse 37
- Ordinary Watercourse 39

Water environment
- Main River
- Ordinary Watercourse
- Drainage pond
- Existing water features (river, ponds, lakes and reservoirs)

Cumulative outfall assessment results: residual effects
- Slight adverse
- Neutral

Note:
1. Only those outfalls included in a cumulative assessment are shown.



Rev.	Rev. Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd
P01	04/08/22	For DCO application	SSz	CW	DS	SG

Development Consent Order Drawing Number: TR010060/APP/6.3

APFP Regulation: Regulation 5(2)(a)

Client: national highways

Project: REGIONAL DELIVERY PARTNERSHIP
A12 CHELMSFORD TO A120 WIDENING SCHEME

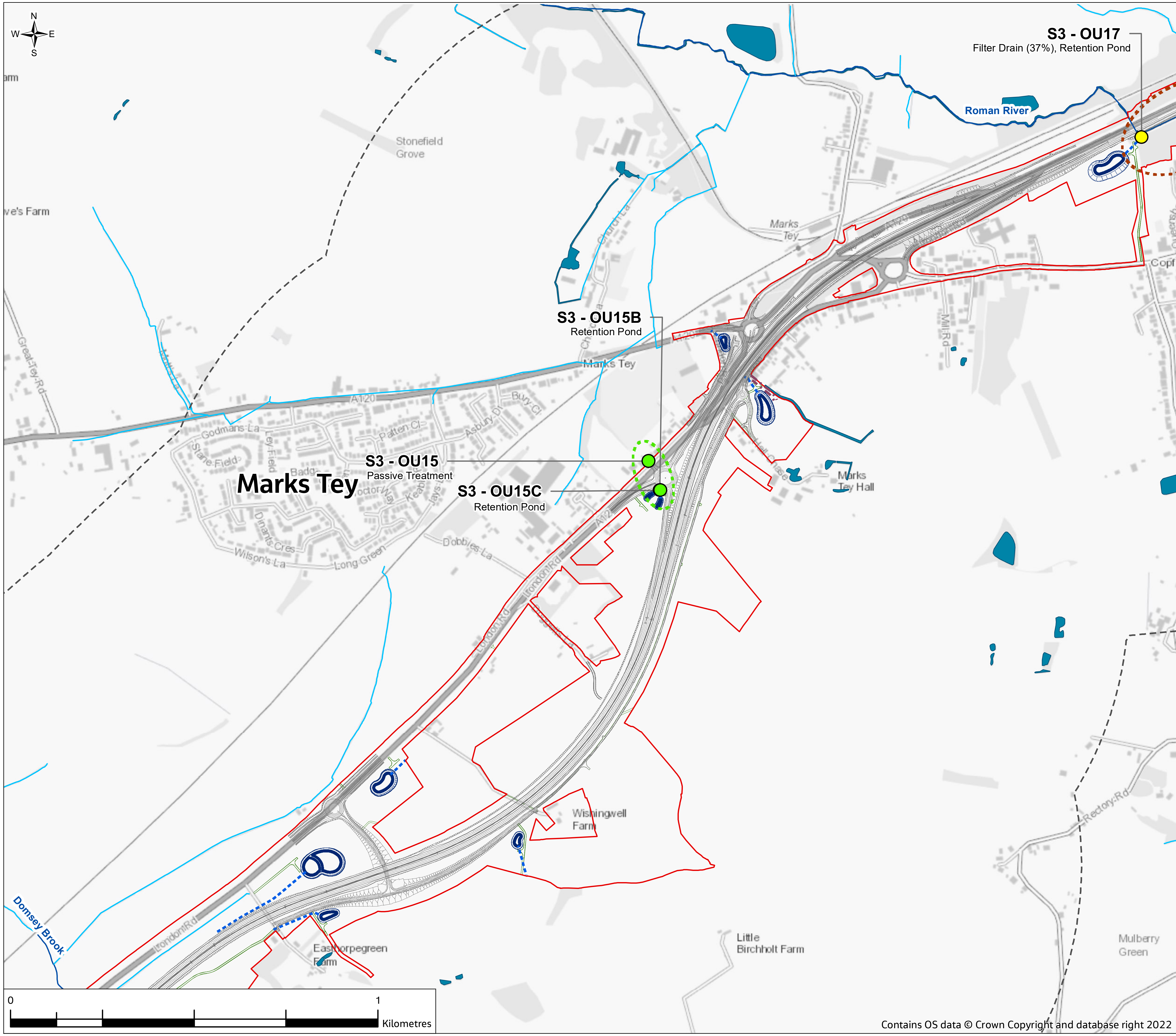
Drawing Title: WATER QUALITY ASSESSMENT REPORT
CUMULATIVE OUTFALL ASSESSMENT RESULTS
SHEET 9 OF 11

Drawing Status: S4 - SUITABLE FOR STAGE APPROVAL

Scale @ A3	1:10000	DO NOT SCALE	
Jacobs No.	B36601D1		
Client No.	HE551497	Rev	P01

Drawing Number: HE551497-JAC-LDC-SCHW-SK-GI-0396

FIGURE 14.1.3



Legend

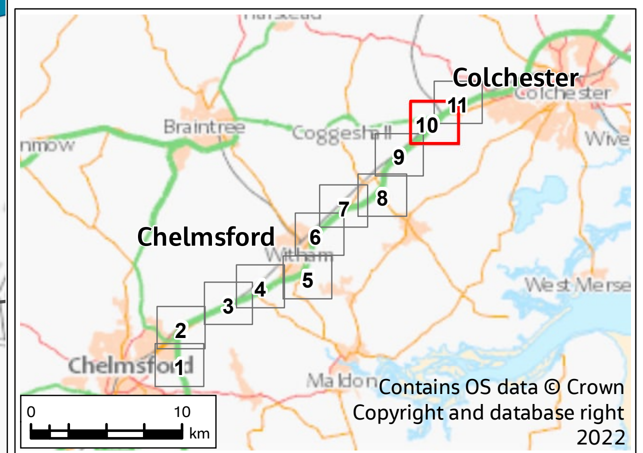
Proposed scheme
- Order Limits
- Scheme
- Study area
- Connection between proposed drainage pond and watercourse
- Temporary roads
- Private means of access and pond access tracks

Cumulative outfall assessment area
- Domsey Brook u/s
- Ordinary Watercourse 26
- Roman River

Water environment
- Main River
- Ordinary Watercourse
- Drainage pond
- Existing water features (river, ponds, lakes and reservoirs)

Cumulative outfall assessment results: residual effects
- Slight adverse
- Neutral

Note:
1. Only those outfalls included in a cumulative assessment are shown.



Rev.	Rev. Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd
P01	04/08/22	For DCO application	SSz	CW	DS	SG

Development Consent Order Drawing Number: TR010060/APP/6.3

APFP Regulation: Regulation 5(2)(a)

Client: national highways

Project: REGIONAL DELIVERY PARTNERSHIP
A12 CHELMSFORD TO A120 WIDENING SCHEME

Drawing Title: WATER QUALITY ASSESSMENT REPORT
CUMULATIVE OUTFALL ASSESSMENT RESULTS
SHEET 10 OF 11

Drawing Status: S4 - SUITABLE FOR STAGE APPROVAL

Scale @ A3	1:10000	DO NOT SCALE
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Client No.	HE551497	Rev P01

Drawing Number: HE551497-JAC-LDC-SCHW-SK-GI-0397

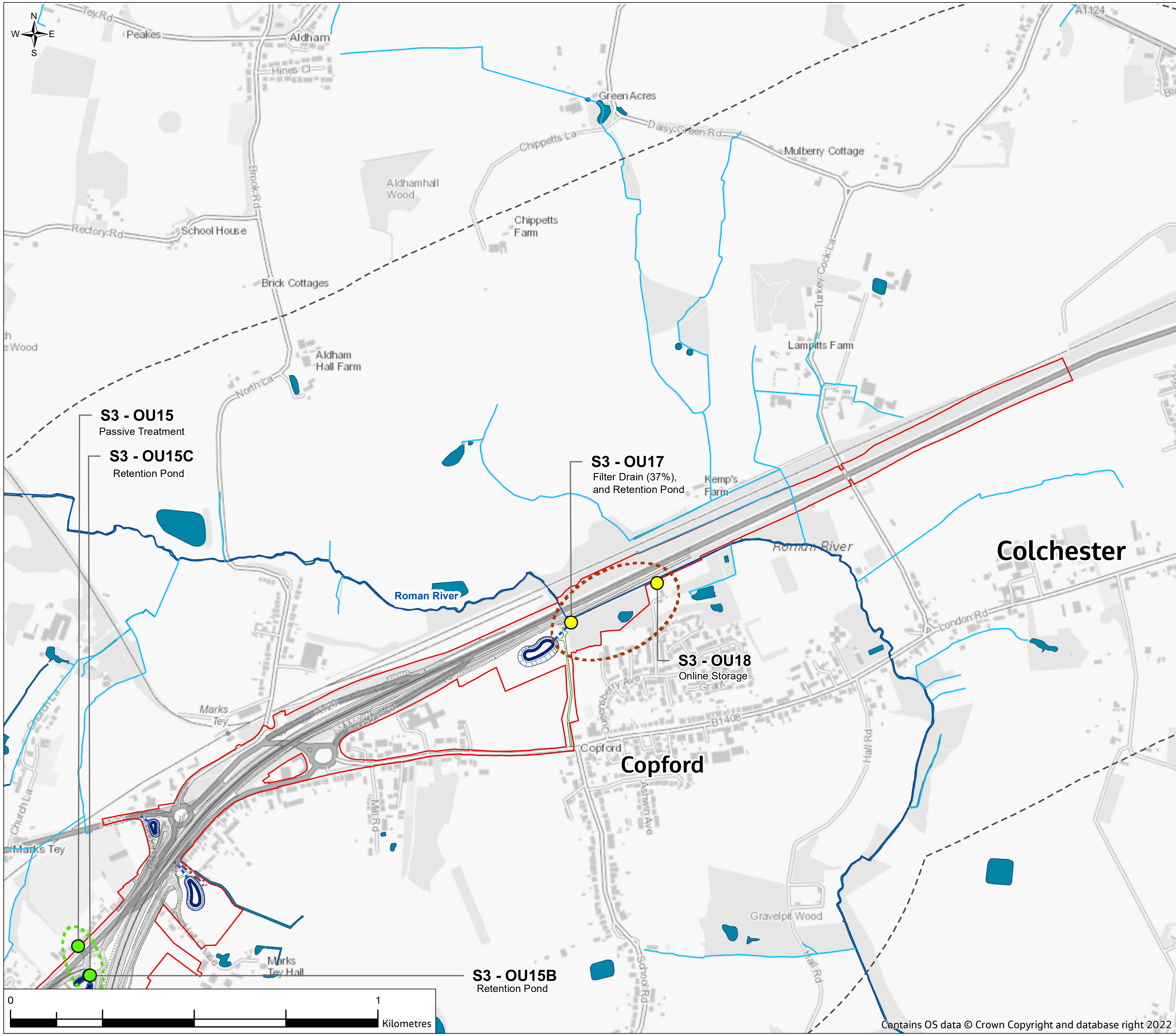


FIGURE 14.1.3

Legend

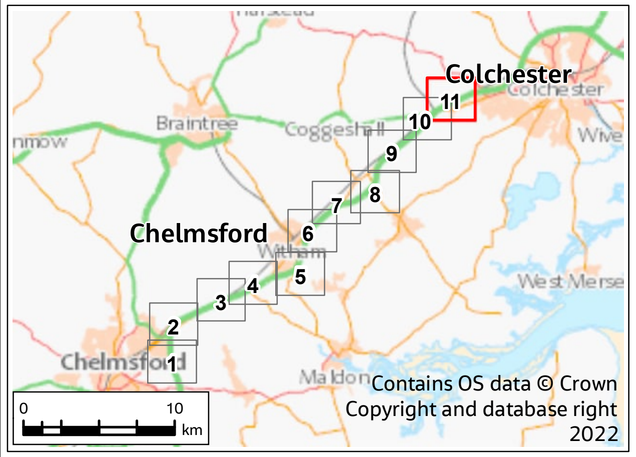
Proposed scheme
- Order Limits
- Scheme
- Study area
- Connection between proposed drainage pond and watercourse
- Temporary roads
- Private means of access and pond access tracks

Cumulative outfall assessment area
- Ordinary Watercourse 26
- Roman River

Water environment
- Main River
- Ordinary Watercourse
- Drainage pond
- Existing water features (river, ponds, lakes and reservoirs)

Cumulative outfall assessment results: residual effects
- Slight adverse
- Neutral

Note:
1. Only those outfalls included in a cumulative assessment are shown.



P01	04/08/22	For DCO application	SSz	CW	DS	SG
Rev.	Rev. Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd

Development Consent Order Drawing Number: TR010060/APP/6.3

APFP Regulation: Regulation 5(2)(a)

Client

national highways

Project

REGIONAL DELIVERY PARTNERSHIP
A12 CHELMSFORD TO A120 WIDENING SCHEME

Drawing Title

WATER QUALITY ASSESSMENT REPORT
CUMULATIVE OUTFALL ASSESSMENT RESULTS
SHEET 11 OF 11

Drawing Status: S4 - SUITABLE FOR STAGE APPROVAL

Scale @ A3	1:10000	DO NOT SCALE
Jacobs No.	B36601D1	
Client No.	HE551497	Rev P01

Drawing Number
HE551497-JAC-LDC-SCHW-SK-GI-0398

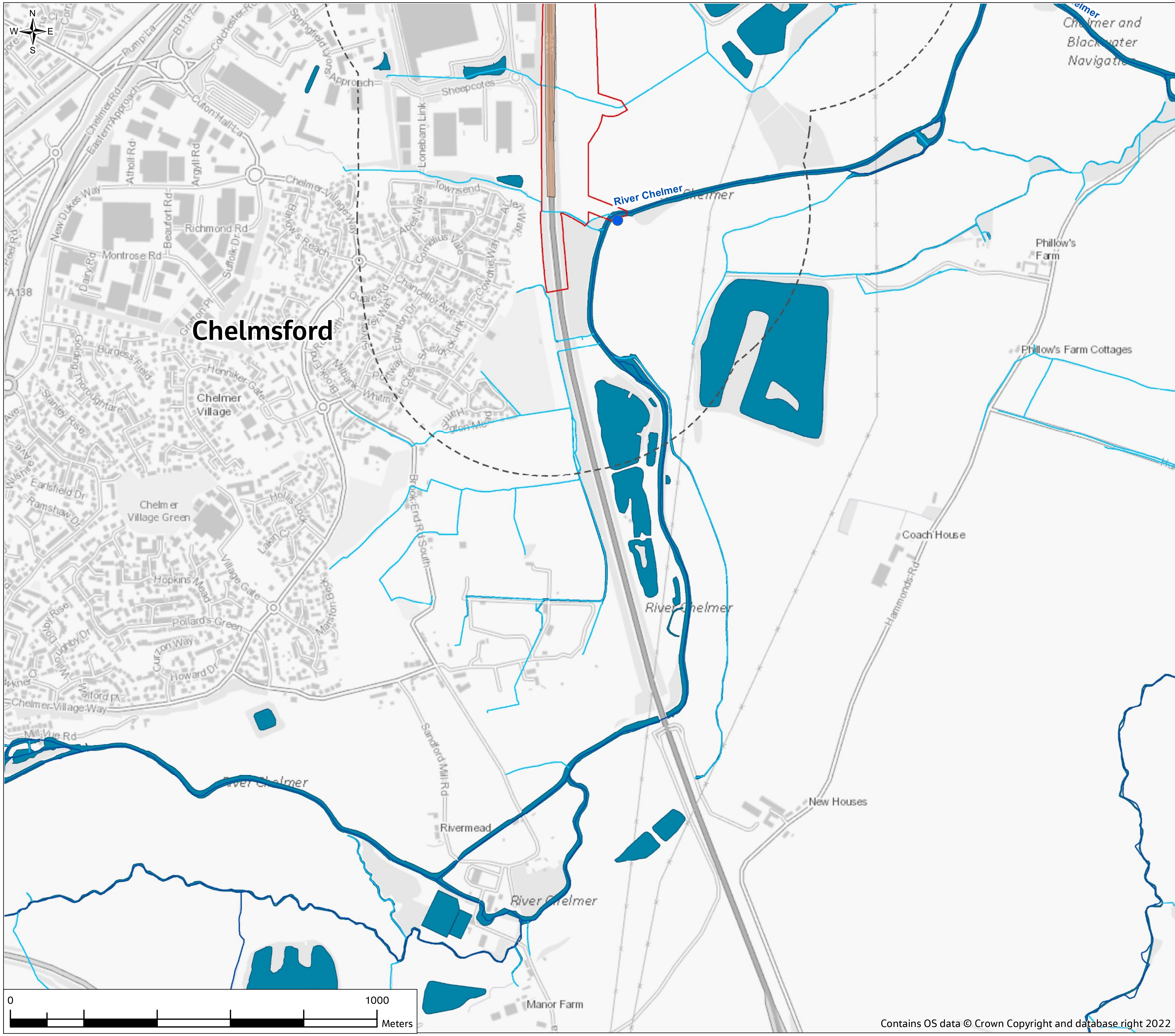


FIGURE 14.1.4

Legend

Proposed scheme

- Order Limits
- Scheme
- Study area

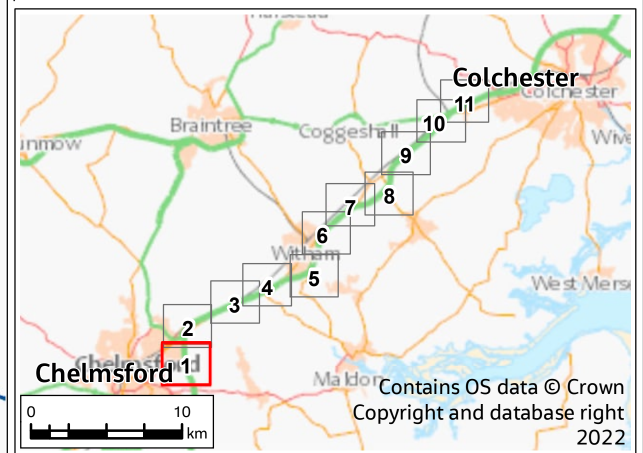
Water environment

- Main River
- Ordinary Watercourse
- Existing water features (river, ponds, lakes and reservoirs)
- Outfall

Catchment area

- S1- OU1

Note:
1. In some locations outfalls discharge to cut-off ditches, these are not currently presented.



Rev.	Rev. Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd
P01	04/08/22	For DCO application	SSz	CW	DS	SG

Development Consent Order Drawing Number: TR010060/APP/6.3

APFP Regulation: Regulation 5(2)(a)

Client

national highways

Project

REGIONAL DELIVERY PARTNERSHIP
A12 CHELMSFORD TO A120 WIDENING SCHEME

Drawing Title

WATER QUALITY ASSESSMENT REPORT
DRAINAGE DESIGN CATCHMENTS
SHEET 1 OF 11

Drawing Status: S4 - SUITABLE FOR STAGE APPROVAL

Scale @ A3	1:10000	DO NOT SCALE	
Jacobs No.	B36601D1		
Client No.	HE551497	Rev	P01

Drawing Number: HE551497-JAC-LDC-SCHW-SK-GI-0399

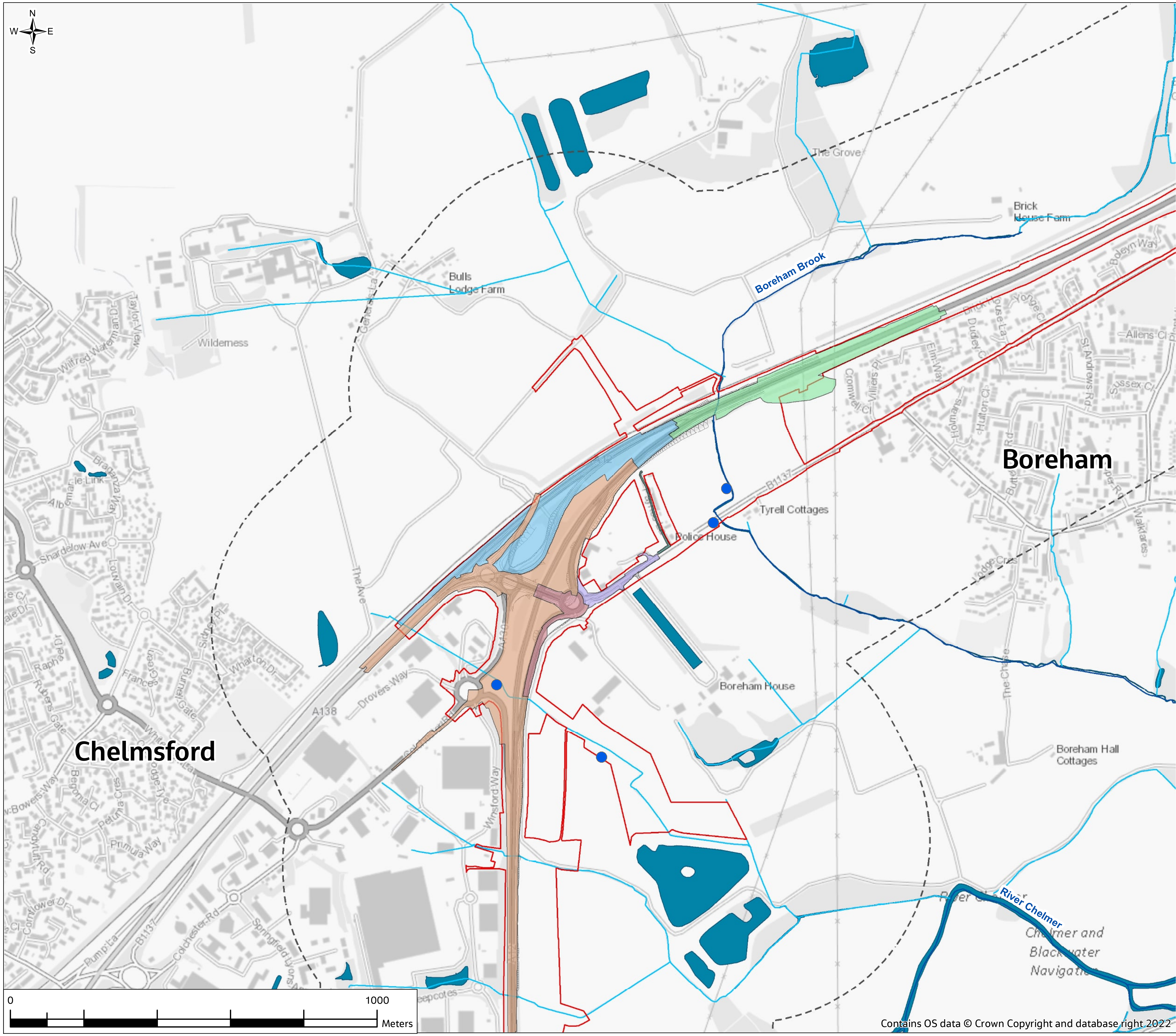


FIGURE 14.1.4

Legend

Proposed scheme

- Order Limits
- Scheme
- Study area

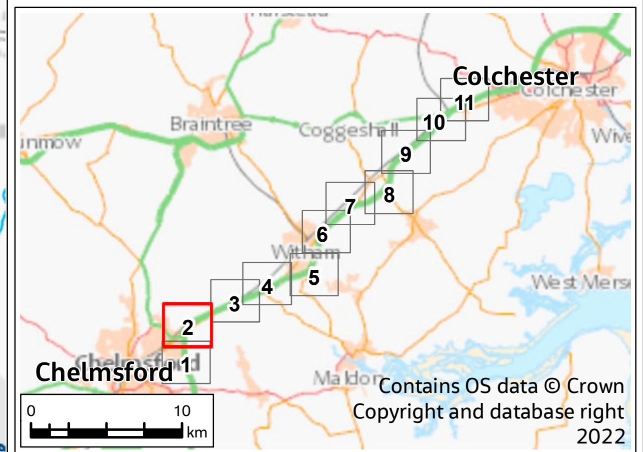
Water environment

- Main River
- Ordinary Watercourse
- Existing water features (river, ponds, lakes and reservoirs)
- Outfall

Catchment area

- S1- OU1
- S1-OU10
- S1-OU10A
- S1-OU11
- S1-OU12
- S1-OU7A

Note:
1. In some locations outfalls discharge to cut-off ditches, these are not currently presented.



P01	04/08/22	For DCO application	SSz	CW	DS	SG
Rev.	Rev. Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd

Development Consent Order Drawing Number: TR010060/APP/6.3

APFP Regulation: Regulation 5(2)(a)

Client

national highways

Project

REGIONAL DELIVERY PARTNERSHIP
A12 CHELMSFORD TO A120 WIDENING SCHEME

Drawing Title

WATER QUALITY ASSESSMENT REPORT
DRAINAGE DESIGN CATCHMENTS
SHEET 2 OF 11

Drawing Status: S4 - SUITABLE FOR STAGE APPROVAL

Scale @ A3	1:10000	DO NOT SCALE
Jacobs No.	B36601D1	
Client No.	HE551497	Rev P01

Drawing Number: HE551497-JAC-LDC-SCHW-SK-GI-0400

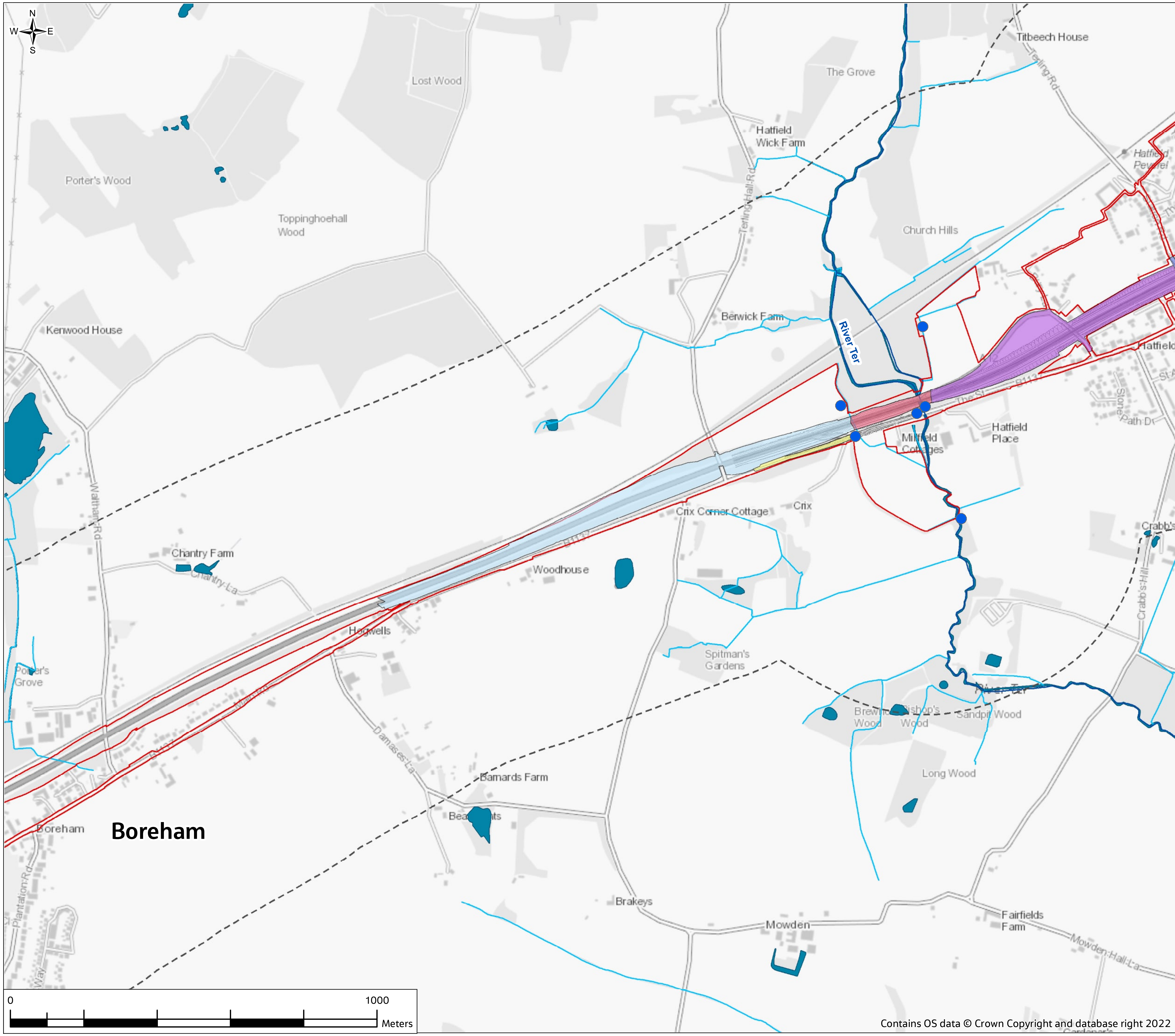


FIGURE 14.1.4

Legend

Proposed scheme

- Order Limits
- Scheme
- Study area

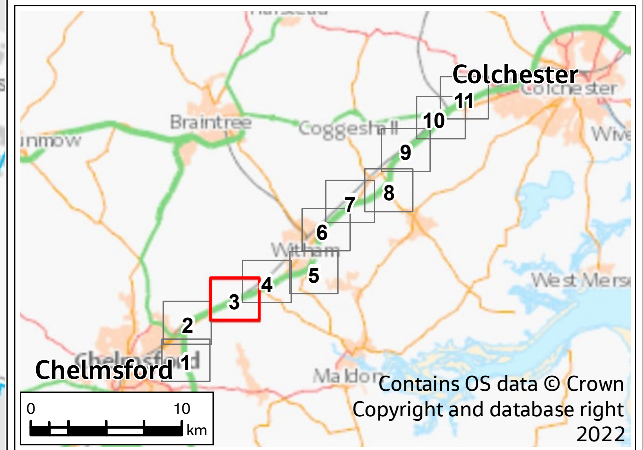
Water environment

- Main River
- Ordinary Watercourse
- Existing water features (river, ponds, lakes and reservoirs)
- Outfall

Catchment area

- S1- OU17
- S1-OU13/OU14
- S1-OU13A
- S1-OU17&18
- S1-OU20

Note:
1. In some locations outfalls discharge to cut-off ditches, these are not currently presented.



Rev.	Rev. Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd
P01	04/08/22	For DCO application	SSz	CW	DS	SG

Development Consent Order Drawing Number: TR010060/APP/6.3

APFP Regulation: Regulation 5(2)(a)

Client

national highways

Project

REGIONAL DELIVERY PARTNERSHIP
A12 CHELMSFORD TO A120 WIDENING SCHEME

Drawing Title

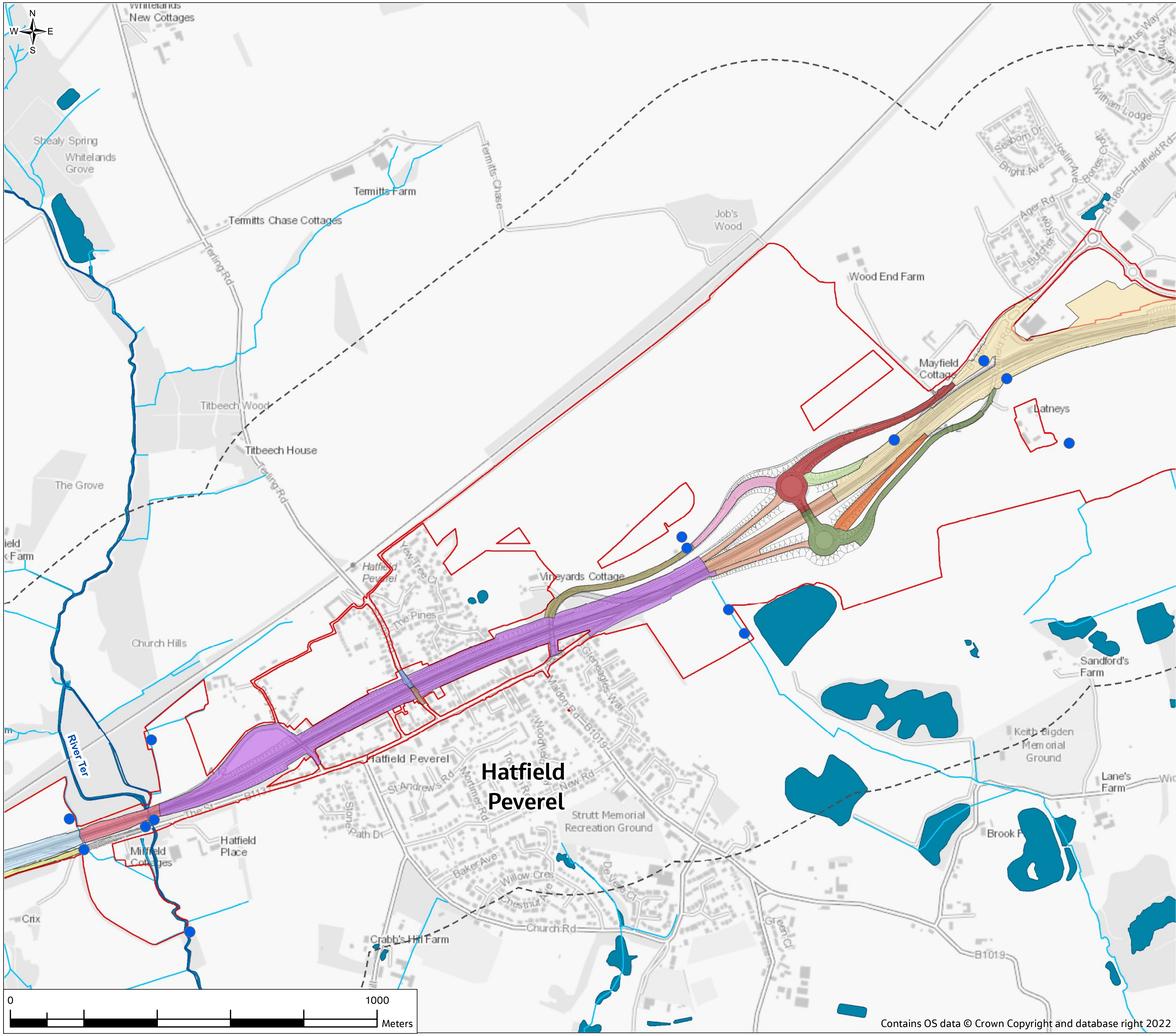
WATER QUALITY ASSESSMENT REPORT
DRAINAGE DESIGN CATCHMENTS
SHEET 3 OF 11

Drawing Status: S4 - SUITABLE FOR STAGE APPROVAL

Scale @ A3	1:10000	DO NOT SCALE
Jacobs No.	B36601D1	
Client No.	HE551497	Rev P01

Drawing Number: HE551497-JAC-LDC-SCHW-SK-GI-0401

FIGURE 14.1.4



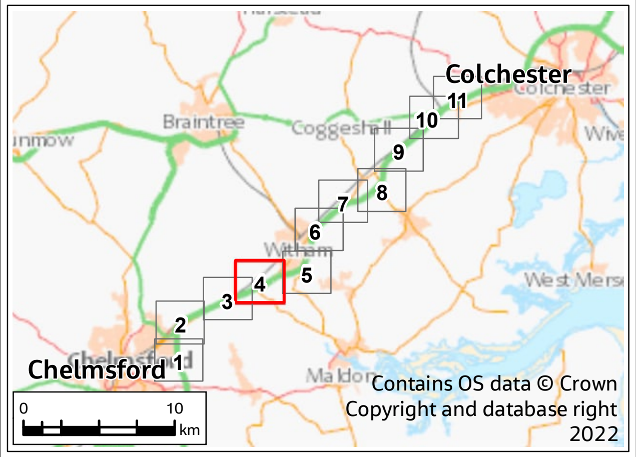
Legend

Proposed scheme
- Order Limits
- Scheme
- Study area

Water environment
- Main River
- Ordinary Watercourse
- Existing water features (river, ponds, lakes and reservoirs)
- Outfall

Catchment area
- S1- OU17
- S1-OU13/OU14
- S1-OU13A
- S1-OU17&18
- S1-OU19
- S1-OU19C
- S1-OU19C1
- S1-OU20
- S1-OU21
- S1-OU23
- S1-OU23C
- S1-OU23D
- S1-OU24A
- S1-OU24B

Note:
1. In some locations outfalls discharge to cut-off ditches, these are not currently presented.



P01	04/08/22	For DCO application	SSz	CW	DS	SG
Rev.	Rev. Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd

Development Consent Order Drawing Number: TR010060/APP/6.3

APFP Regulation: Regulation 5(2)(a)

Client

national highways

Project

REGIONAL DELIVERY PARTNERSHIP
A12 CHELMSFORD TO A120 WIDENING SCHEME

Drawing Title

WATER QUALITY ASSESSMENT REPORT
DRAINAGE DESIGN CATCHMENTS
SHEET 4 OF 11

Drawing Status: S4 - SUITABLE FOR STAGE APPROVAL

Scale @ A3	1:10000	DO NOT SCALE
Jacobs No.	B36601D1	
Client No.	HE551497	Rev P01

Drawing Number: HE551497-JAC-LDC-SCHW-SK-GI-0402

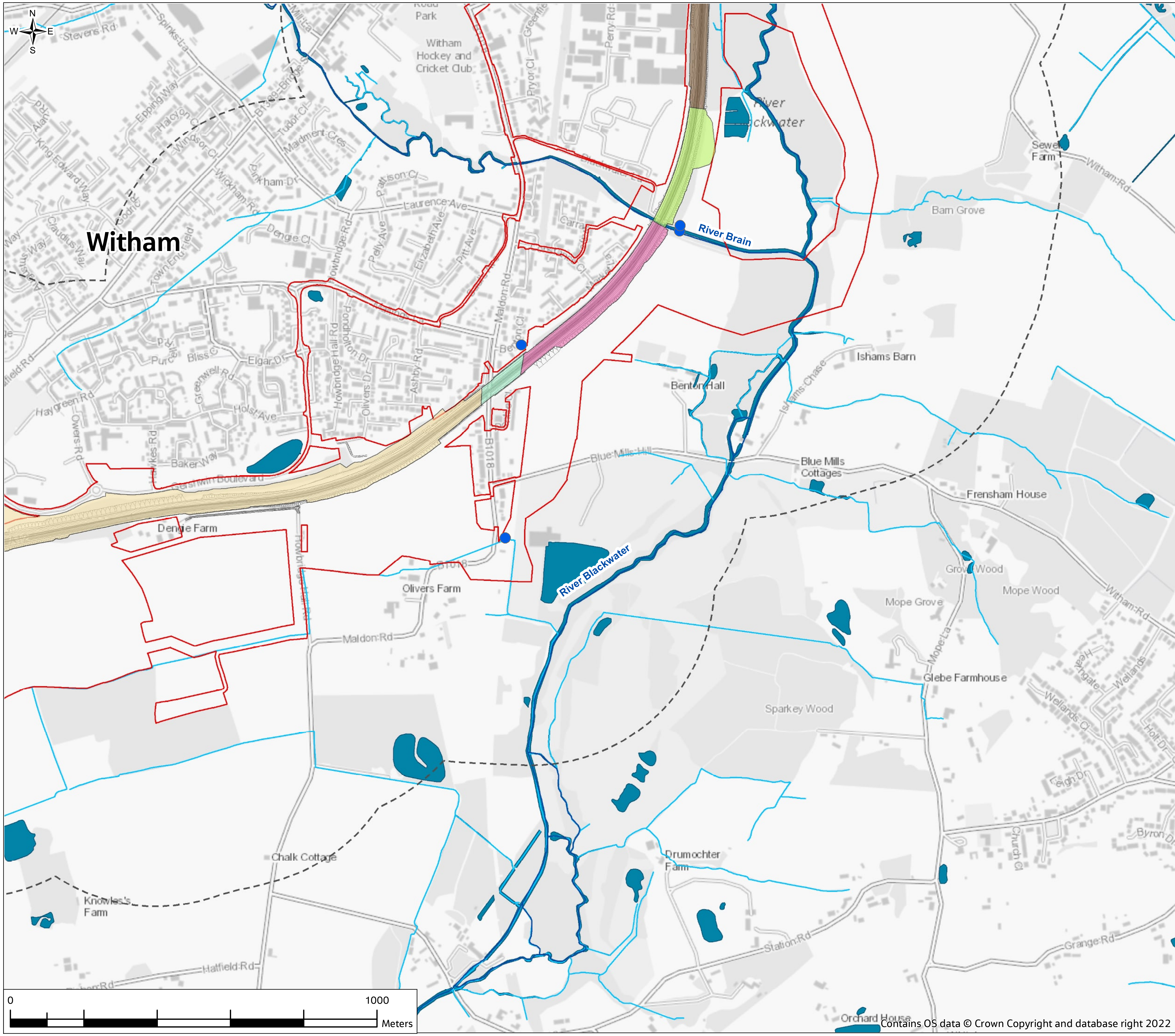


FIGURE 14.1.4

Legend

Proposed scheme

- Order Limits
- Scheme
- Study area

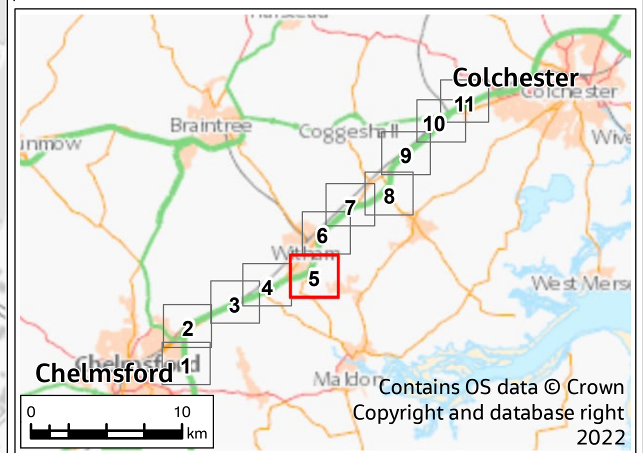
Water environment

- Main River
- Ordinary Watercourse
- Existing water features (river, ponds, lakes and reservoirs)
- Outfall

Catchment area

- S1-OU23
- S2-OU3
- S2-OU4
- S2-OU5
- S2-OU8

Note:
1. In some locations outfalls discharge to cut-off ditches, these are not currently presented.



P01	04/08/22	For DCO application	SSz	CW	DS	SG
Rev.	Rev. Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd

Development Consent Order Drawing Number: TR010060/APP/6.3

APFP Regulation: Regulation 5(2)(a)

Client: national highways

Project: REGIONAL DELIVERY PARTNERSHIP
A12 CHELMSFORD TO A120 WIDENING SCHEME

Drawing Title: WATER QUALITY ASSESSMENT REPORT
DRAINAGE DESIGN CATCHMENTS
SHEET 5 OF 11

Drawing Status: S4 - SUITABLE FOR STAGE APPROVAL

Scale @ A3	1:10000	DO NOT SCALE
Jacobs No.	B36601D1	
Client No.	HE551497	Rev P01

Drawing Number: HE551497-JAC-LDC-SCHW-SK-GI-0403

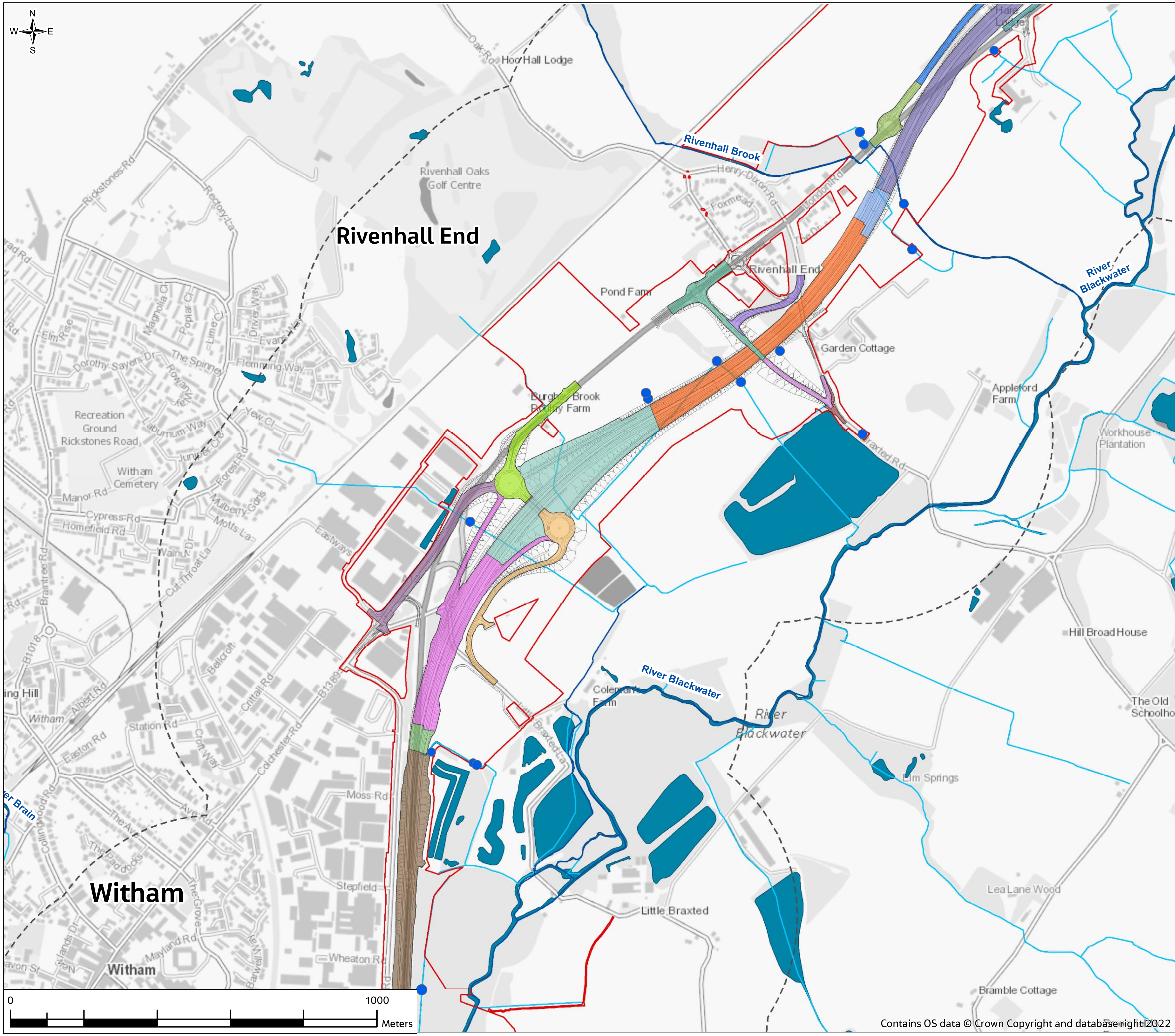


FIGURE 14.1.4

Legend

Proposed scheme

- Order Limits
- Scheme
- Study area

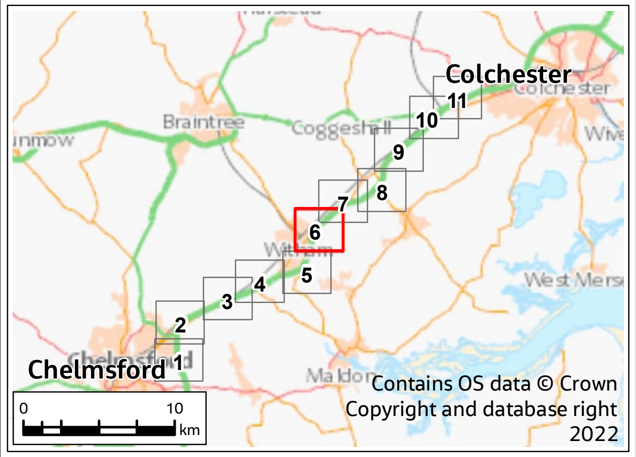
Water environment

- Main River
- Ordinary Watercourse
- Existing water features (river, ponds, lakes and reservoirs)
- Outfall

Catchment area

- S2-OU10
- S2-OU11
- S2-OU14
- S2-OU15A
- S2-OU15C
- S2-OU15C
- S2-OU15C1
- S2-OU15D
- S2-OU15D1
- S2-OU15E
- S2-OU15G
- S2-OU24
- S2-OU24A
- S2-OU26
- S2-OU8
- S2-OU9
- S2-OU9A

Note:
1. In some locations outfalls discharge to cut-off ditches, these are not currently presented.



Rev.	Rev. Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd
P01	04/08/22	For DCO application	SSz	CW	DS	SG

Development Consent Order Drawing Number: TR010060/APP/6.3

APFP Regulation: Regulation 5(2)(a)

Client

national highways

Project

REGIONAL DELIVERY PARTNERSHIP
A12 CHELMSFORD TO A120 WIDENING SCHEME

Drawing Title

WATER QUALITY ASSESSMENT REPORT
DRAINAGE DESIGN CATCHMENTS
SHEET 6 OF 11

Drawing Status: S4 - SUITABLE FOR STAGE APPROVAL

Scale @ A3	1:10000	DO NOT SCALE
Jacobs No.	B36601D1	
Client No.	HE551497	Rev P01

Drawing Number: HE551497-JAC-LDC-SCHW-SK-GI-0404

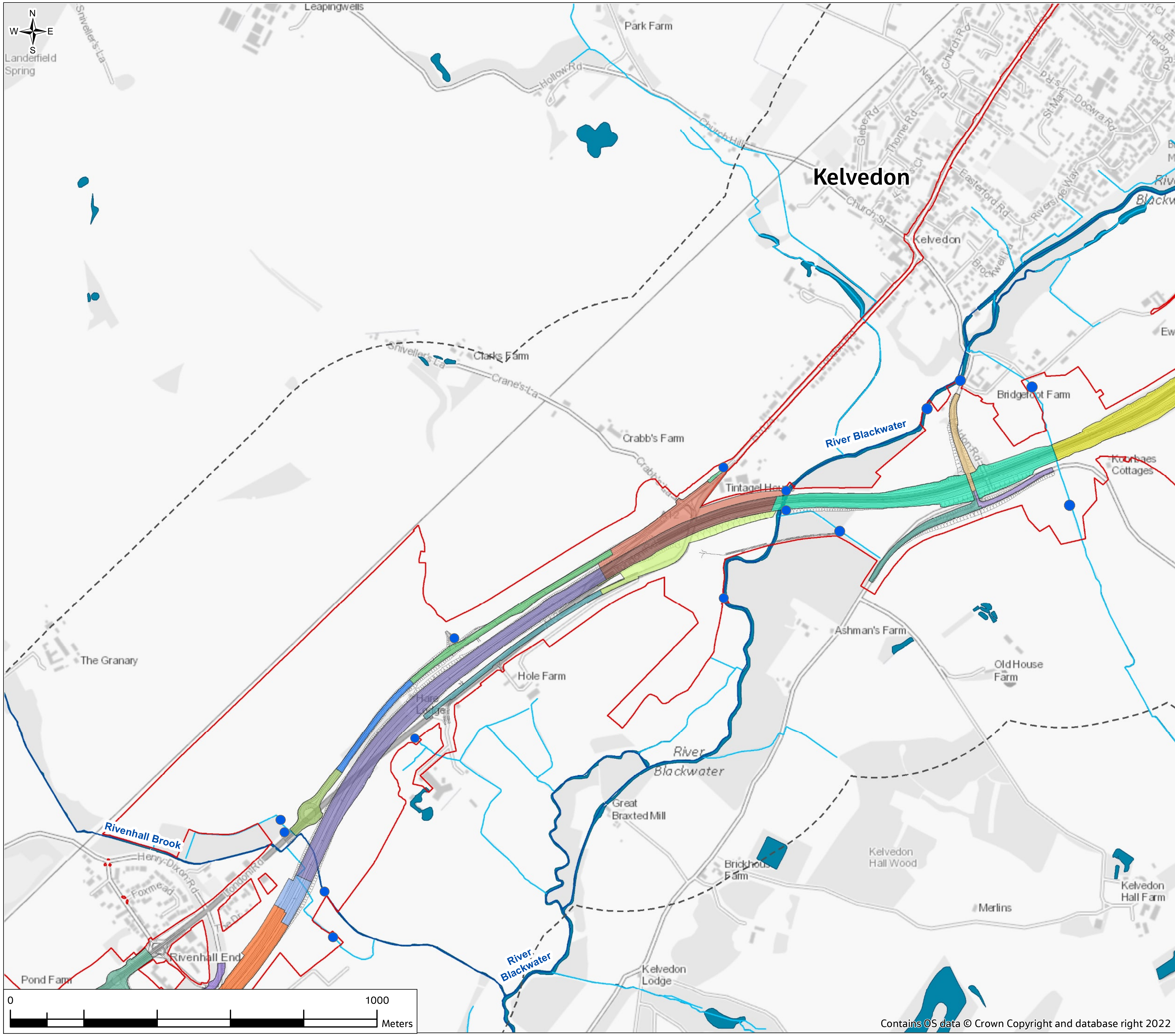


FIGURE 14.1.4

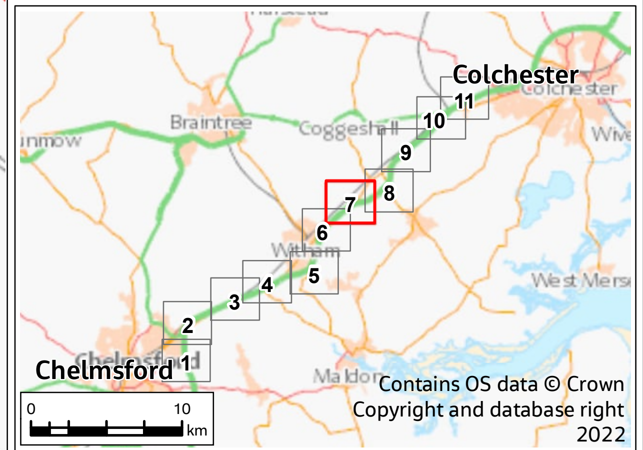
Legend

Proposed scheme
- Order Limits
- Scheme
- Study area

Water environment
- Main River
- Ordinary Watercourse
- Existing water features (river, ponds, lakes and reservoirs)
- Outfall

Catchment area
- S2-OU15C
- S2-OU15C
- S2-OU15C1
- S2-OU15E
- S2-OU15G
- S2-OU15H
- S2-OU17
- S2-OU18
- S2-OU19
- S2-OU24
- S2-OU24A
- S2-OU26
- S2-OU27
- S3-OU1
- S3-OU2
- S3-OU3
- S3-OU4
- S3-OU5

Note:
1. In some locations outfalls discharge to cut-off ditches, these are not currently presented.



P01	04/08/22	For DCO application	SSz	CW	DS	SG
Rev.	Rev. Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd

Development Consent Order Drawing Number: TR010060/APP/6.3

APFP Regulation: Regulation 5(2)(a)

Client: national highways

Project: REGIONAL DELIVERY PARTNERSHIP
A12 CHELMSFORD TO A120 WIDENING SCHEME

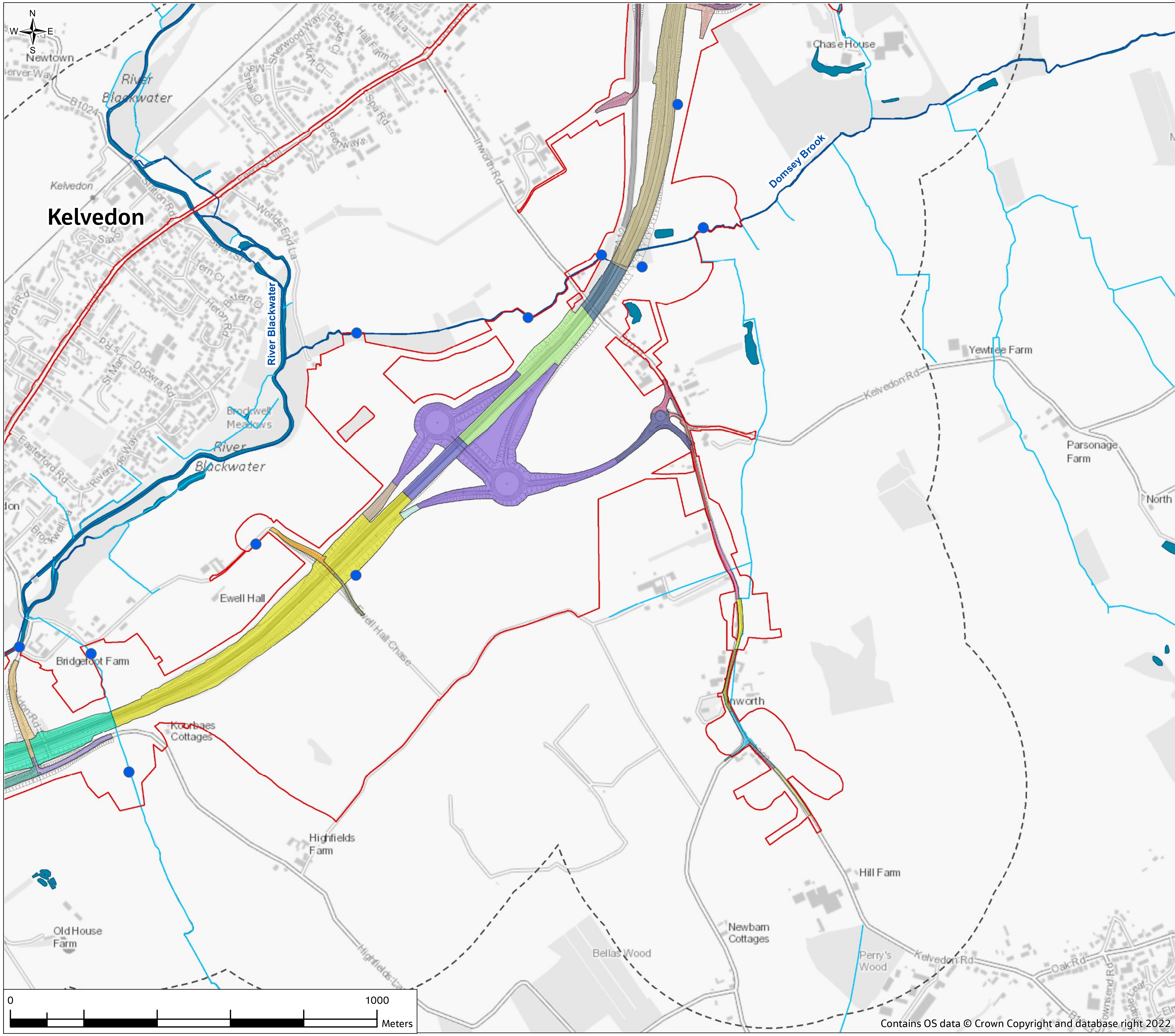
Drawing Title: WATER QUALITY ASSESSMENT REPORT
DRAINAGE DESIGN CATCHMENTS
SHEET 7 OF 11

Drawing Status: S4 - SUITABLE FOR STAGE APPROVAL

Scale @ A3	1:10000	DO NOT SCALE
Jacobs No.	B36601D1	
Client No.	HE551497	Rev P01

Drawing Number: HE551497-JAC-LDC-SCHW-SK-GI-0405

FIGURE 14.1.4



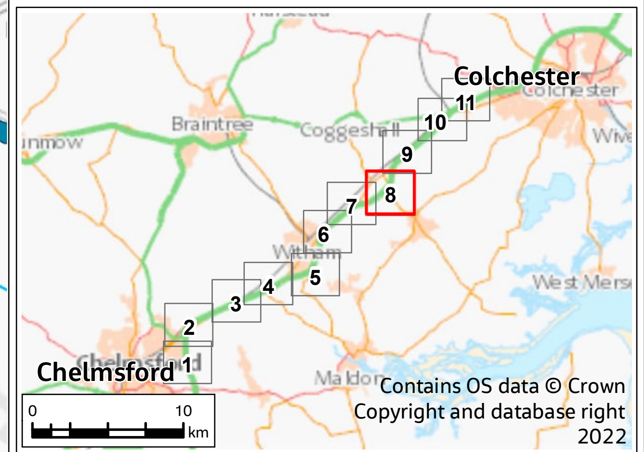
Legend

Proposed scheme
- Order Limits
- Scheme
- Study area

Water environment
- Main River
- Ordinary Watercourse
- Existing water features (river, ponds, lakes and reservoirs)
- Outfall

Catchment area
- IWR-OU1
- IWR-OU2
- IWR-OU3
- IWR-OU4
- IWR-OU5
- IWR-OU6
- IWR-OU7
- S3-OU1
- S3-OU10
- S3-OU13
- S3-OU14
- S3-OU19
- S3-OU2
- S3-OU20
- S3-OU22
- S3-OU3
- S3-OU4
- S3-OU5
- S3-OU6
- S3-OU7
- S3-OU7A
- S3-OU8
- S3-OU8A
- S3-OU8B/S3-OU8D
- S3-OU8C
- S3-OU8E
- S3-OU9

Note:
1. In some locations outfalls discharge to cut-off ditches, these are not currently presented.



Rev.	Rev. Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd
P01	04/08/22	For DCO application	SSz	CW	DS	SG

Development Consent Order Drawing Number: TR010060/APP/6.3

APFP Regulation: Regulation 5(2)(a)

Client: national highways

Project: REGIONAL DELIVERY PARTNERSHIP
A12 CHELMSFORD TO A120 WIDENING SCHEME

Drawing Title: WATER QUALITY ASSESSMENT REPORT
DRAINAGE DESIGN CATCHMENTS
SHEET 8 OF 11

Drawing Status: S4 - SUITABLE FOR STAGE APPROVAL

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Client No.	HE551497	Rev P01

Drawing Number: HE551497-JAC-LDC-SCHW-SK-GI-0406

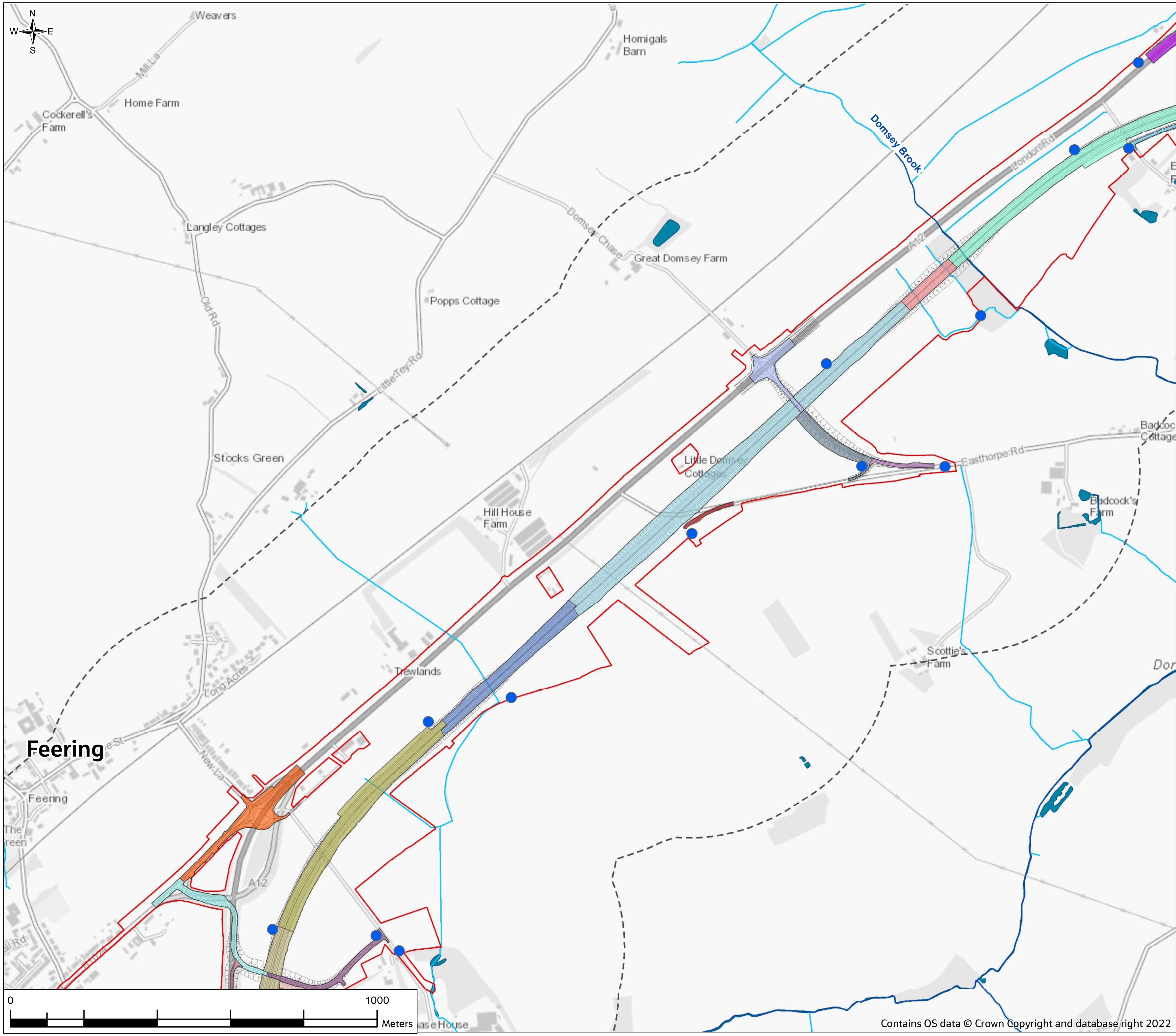


FIGURE 14.1.4

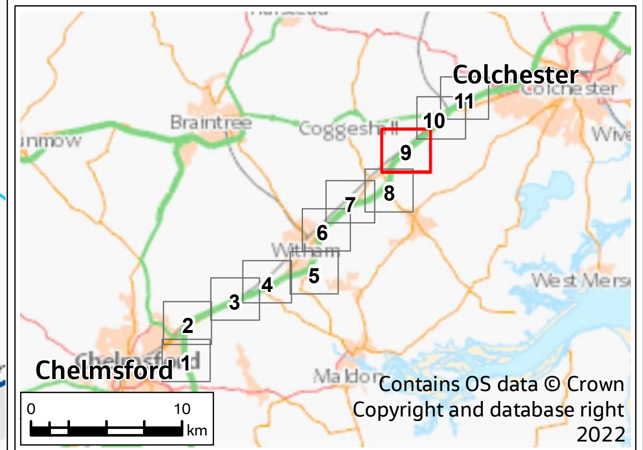
Legend

Proposed scheme
- Order Limits
- Scheme
- Study area

Water environment
- Main River
- Ordinary Watercourse
- Existing water features (river, ponds, lakes and reservoirs)
- Outfall

Catchment area
- S3-OU10
- S3-OU19
- S3-OU20
- S3-OU21
- S3-OU22
- S3-OU23
- S3-OU24
- S3-OU26
- S3-OU268
- S3-OU26A
- S3-OU27
- S3-OU27A
- S3-OU28
- S3-OU29
- S3-OU30
- S3-OU31
- S3-OU33

Note:
1. In some locations outfalls discharge to cut-off ditches, these are not currently presented.



P01	04/08/22	For DCO application	SSz	CW	DS	SG
Rev.	Rev. Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd

Development Consent Order Drawing Number: TR010060/APP/6.3

APFP Regulation: Regulation 5(2)(a)

Client: national highways

Project: REGIONAL DELIVERY PARTNERSHIP
A12 CHELMSFORD TO A120 WIDENING SCHEME

Drawing Title: WATER QUALITY ASSESSMENT REPORT
DRAINAGE DESIGN CATCHMENTS
SHEET 9 OF 11

Drawing Status: S4 - SUITABLE FOR STAGE APPROVAL

Scale @ A3	1:10000	DO NOT SCALE
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Client No.	HE551497	Rev P01

Drawing Number: HE551497-JAC-LDC-SCHW-SK-GI-0407

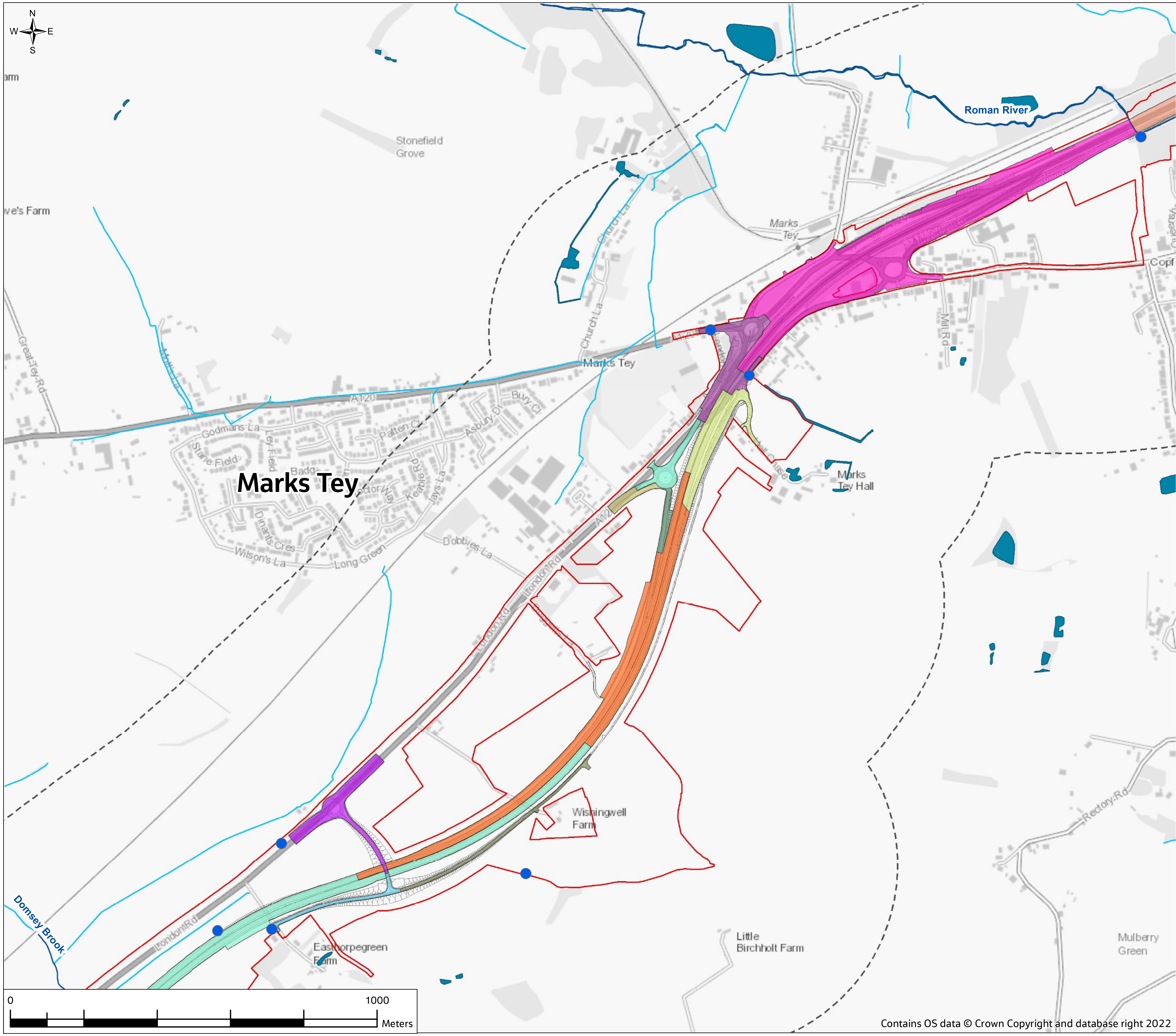


FIGURE 14.1.4

Legend

Proposed scheme

- Order Limits
- Scheme
- Study area

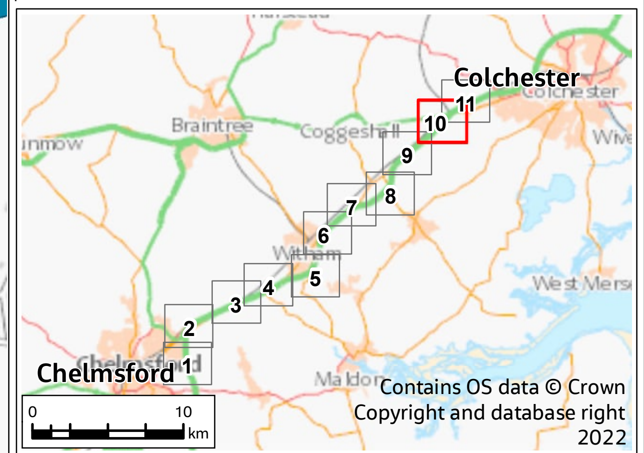
Water environment

- Main River
- Ordinary Watercourse
- Existing water features (river, ponds, lakes and reservoirs)
- Outfall

Catchment area

- S3-OU15
- S3-OU15A
- S3-OU15B
- S3-OU15C
- S3-OU16
- S3-OU17
- S3-OU18
- S3-OU30
- S3-OU30A
- S3-OU31
- S3-OU32
- S3-OU33

Note:
1. In some locations outfalls discharge to cut-off ditches, these are not currently presented.



Rev.	Rev. Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd
P01	04/08/22	For DCO application	SSz	CW	DS	SG

Development Consent Order Drawing Number: TR010060/APP/6.3

APFP Regulation: Regulation 5(2)(a)

Client: national highways

Project: REGIONAL DELIVERY PARTNERSHIP
A12 CHELMSFORD TO A120 WIDENING SCHEME

Drawing Title: WATER QUALITY ASSESSMENT REPORT
DRAINAGE DESIGN CATCHMENTS
SHEET 10 OF 11

Drawing Status: S4 - SUITABLE FOR STAGE APPROVAL

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Client No.	HE551497	Rev P01

Drawing Number: HE551497-JAC-LDC-SCHW-SK-GI-0408

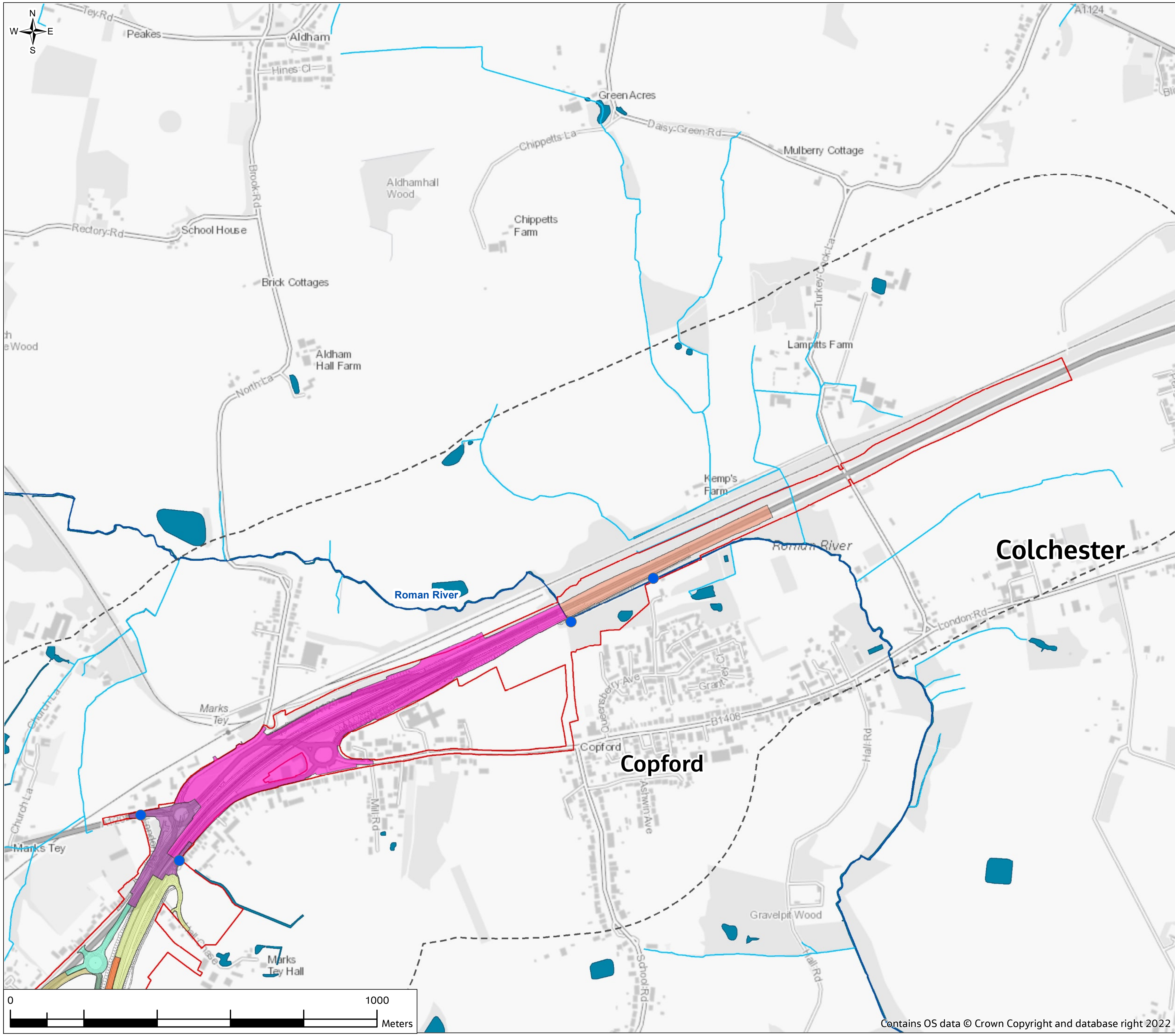


FIGURE 14.1.4

Legend

Proposed scheme

- Order Limits
- Scheme
- Study area

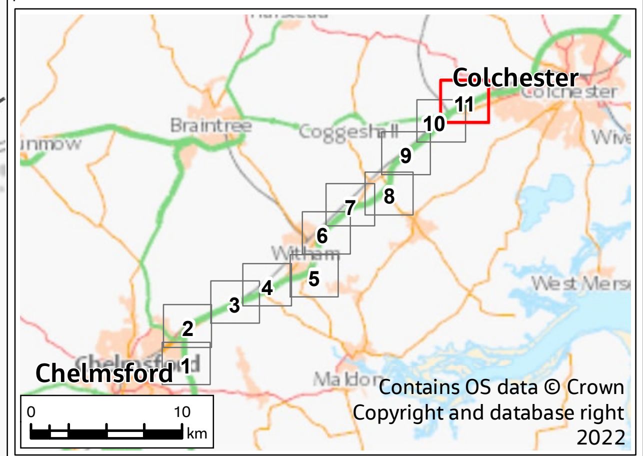
Water environment

- Main River
- Ordinary Watercourse
- Existing water features (river, ponds, lakes and reservoirs)
- Outfall

Catchment area

- S3-OU15
- S3-OU15A
- S3-OU15B
- S3-OU15C
- S3-OU16
- S3-OU17
- S3-OU18
- S3-OU30A

Note:
1. In some locations outfalls discharge to cut-off ditches, these are not currently presented.



Rev.	Rev. Date	Purpose of revision	Drawn	Check'd	Rev'd	Appr'd
P01	04/08/22	For DCO application	SSz	CW	DS	SG

Development Consent Order Drawing Number: TR010060/APP/6.3

APFP Regulation: Regulation 5(2)(a)

Client

national highways

Project

REGIONAL DELIVERY PARTNERSHIP
A12 CHELMSFORD TO A120 WIDENING SCHEME

Drawing Title

WATER QUALITY ASSESSMENT REPORT
DRAINAGE DESIGN CATCHMENTS
SHEET 11 OF 11

Drawing Status: S4 - SUITABLE FOR STAGE APPROVAL

Scale @ A3	1:10000	DO NOT SCALE
Jacobs No.	B36601D1	
Client No.	HE551497	Rev P01

Drawing Number: HE551497-JAC-LDC-SCHW-SK-GI-0409

Annex H Groundwater assessment tables

Table H.1 HEWRAT groundwater screening assessment for outfalls to low flow watercourses.

Design Section	Outfall ID	Traffic density	Rainfall depth - annual average	Drainage area ratio	Infiltration method	Unsaturated zone	Flow type	Unsaturated zone clay content	Organic carbon	Unsaturated zone soil pH	Total Score	GW Risk Factor
1	S1 - OU7	≤50,000 AADT	≤740mm	>50 to <150	‘Continuous’ shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	≥15% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	160	Medium
1	S1 - OU7A	≤50,000 AADT	≤740mm	>50 to <150	‘Continuous’ shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table <15m and >5m	Dominantly intergranular flow	≥15% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	140	Low
1	S1 - OU14	≥100,000 AADT	≤740mm	>50 to <150	‘Continuous’ shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	<15% to > 1% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	185	Medium

Design Section	Outfall ID	Traffic density	Rainfall depth - annual average	Drainage area ratio	Infiltration method	Unsaturated zone	Flow type	Unsaturated zone clay content	Organic carbon	Unsaturated zone soil pH	Total Score	GW Risk Factor
1	S1 - OU13A	≤50,000 AADT	≤740mm	>50 to <150	'Continuous' shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	<15% to > 1% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	165	Medium
1	S1-OU18	≥100,000 AADT	≤740mm	>50 to <150	'Continuous' shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	≥15% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	180	Medium
1	S1 - OU19	>50,000 to <100,000 AADT	≤740mm	>50 to <150	'Continuous' shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	≥15% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	170	Medium

Design Section	Outfall ID	Traffic density	Rainfall depth - annual average	Drainage area ratio	Infiltration method	Unsaturated zone	Flow type	Unsaturated zone clay content	Organic carbon	Unsaturated zone soil pH	Total Score	GW Risk Factor
1	S1 - OU19C	≤50,000 AADT	≤740mm	>50 to <150	'Continuous' shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	≥15% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	160	Medium
1	S1-OU19C1	≤50,000 AADT	≤740mm	>50 to <150	'Continuous' shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	≥15% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	160	Medium
1	S1 - OU23	≥100,000 AADT	≤740mm	>50 to <150	'Continuous' shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	<15% to > 1% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	185	Medium

Design Section	Outfall ID	Traffic density	Rainfall depth - annual average	Drainage area ratio	Infiltration method	Unsaturated zone	Flow type	Unsaturated zone clay content	Organic carbon	Unsaturated zone soil pH	Total Score	GW Risk Factor
1	S1 - OU23C	≤50,000 AADT	≤740mm	>50 to <150	'Continuous' shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	≥15% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	160	Medium
1	S1 - OU23D	≤50,000 AADT	≤740mm	>50 to <150	'Continuous' shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	≥15% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	160	Medium
1	S1 - OU24A	≤50,000 AADT	≤740mm	>50 to <150	'Continuous' shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	≥15% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	160	Medium

Design Section	Outfall ID	Traffic density	Rainfall depth - annual average	Drainage area ratio	Infiltration method	Unsaturated zone	Flow type	Unsaturated zone clay content	Organic carbon	Unsaturated zone soil pH	Total Score	GW Risk Factor
1	S1-OU24B	≤50,000 AADT	≤740mm	>50 to <150	‘Continuous’ shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	≥15% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	160	Medium
2	S2-OU03	≥100,000 AADT	≤740mm	>50 to <150	‘Continuous’ shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	<15% to > 1% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	185	Medium
2	S2 - OU8	≥100,000 AADT	≤740mm	>50 to <150	‘Continuous’ shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table <15m and >5m	Dominantly intergranular flow	≥15% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	160	Medium

Design Section	Outfall ID	Traffic density	Rainfall depth - annual average	Drainage area ratio	Infiltration method	Unsaturated zone	Flow type	Unsaturated zone clay content	Organic carbon	Unsaturated zone soil pH	Total Score	GW Risk Factor
2	S2 - OU9	≥100,000 AADT	≤740mm	>50 to <150	‘Continuous’ shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	<15% to > 1% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	185	Medium
2	S2-OU9A	≥100,000 AADT	≤740mm	>50 to <150	‘Continuous’ shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table <15m and >5m	Dominantly intergranular flow	<15% to > 1% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	165	Medium
2	S2-OU10	≤50,000 AADT	≤740mm	>50 to <150	‘Continuous’ shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	<15% to > 1% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	165	Medium

Design Section	Outfall ID	Traffic density	Rainfall depth - annual average	Drainage area ratio	Infiltration method	Unsaturated zone	Flow type	Unsaturated zone clay content	Organic carbon	Unsaturated zone soil pH	Total Score	GW Risk Factor
2	S2-OU11	≤50,000 AADT	≤740mm	>50 to <150	'Continuous' shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table <15m and >5m	Dominantly intergranular flow	<15% to > 1% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	145	Low
2	S2-OU14	≤50,000 AADT	≤740mm	>50 to <150	'Continuous' shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table <15m and >5m	Dominantly intergranular flow	<15% to > 1% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	145	Low
2	S2 - OU15A	>50,000 to <100,000 AADT	≤740mm	>50 to <150	'Continuous' shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table <15m and >5m	Dominantly intergranular flow	<15% to > 1% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	155	Medium

Design Section	Outfall ID	Traffic density	Rainfall depth - annual average	Drainage area ratio	Infiltration method	Unsaturated zone	Flow type	Unsaturated zone clay content	Organic carbon	Unsaturated zone soil pH	Total Score	GW Risk Factor
2	S2 - OU15C	≥100,000 AADT	≤740mm	>50 to <150	'Continuous' shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	<15% to > 1% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	185	Medium
2	S2 - OU15C1	≥100,000 AADT	≤740mm	>50 to <150	'Continuous' shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	≥15% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	180	Medium
2	S2 - OU15D	≤50,000 AADT	≤740mm	>50 to <150	'Continuous' shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	<15% to > 1% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	165	Medium

Design Section	Outfall ID	Traffic density	Rainfall depth - annual average	Drainage area ratio	Infiltration method	Unsaturated zone	Flow type	Unsaturated zone clay content	Organic carbon	Unsaturated zone soil pH	Total Score	GW Risk Factor
2	S2 - OU15E	≤50,000 AADT	≤740mm	>50 to <150	'Continuous' shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	<15% to > 1% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	165	Medium
2	S2 - OU26	≤50,000 AADT	≤740mm	>50 to <150	'Continuous' shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	<15% to > 1% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	165	Medium
2	S2-OU27	≥100,000 AADT	≤740mm	>50 to <150	'Continuous' shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	<15% to > 1% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	185	Medium

Design Section	Outfall ID	Traffic density	Rainfall depth - annual average	Drainage area ratio	Infiltration method	Unsaturated zone	Flow type	Unsaturated zone clay content	Organic carbon	Unsaturated zone soil pH	Total Score	GW Risk Factor
3	S3-OU2	≥100,000 AADT	≤740mm	>50 to <150	‘Continuous’ shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	<15% to > 1% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	185	Medium
3	S3 - OU3	≤50,000 AADT	≤740mm	>50 to <150	‘Continuous’ shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	<15% to > 1% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	165	Medium
3	S3 - OU4	≤50,000 AADT	≤740mm	>50 to <150	‘Continuous’ shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	<15% to > 1% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	165	Medium

Design Section	Outfall ID	Traffic density	Rainfall depth - annual average	Drainage area ratio	Infiltration method	Unsaturated zone	Flow type	Unsaturated zone clay content	Organic carbon	Unsaturated zone soil pH	Total Score	GW Risk Factor
3	S3 - OU6	≤50,000 AADT	≤740mm	>50 to <150	‘Continuous’ shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	≥15% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	160	Medium
3	S3 - OU7A	≤50,000 AADT	≤740mm	>50 to <150	‘Continuous’ shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	≥15% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	160	Medium
3	S3-OU8B & 8D	≤50,000 AADT	≤740mm	>50 to <150	‘Continuous’ shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	≥15% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	160	Medium

Design Section	Outfall ID	Traffic density	Rainfall depth - annual average	Drainage area ratio	Infiltration method	Unsaturated zone	Flow type	Unsaturated zone clay content	Organic carbon	Unsaturated zone soil pH	Total Score	GW Risk Factor
3	S3-OU8C	≤50,000 AADT	≤740mm	>50 to <150	'Continuous' shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	≥15% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	160	Medium
3	S3-OU8E	≤50,000 AADT	≤740mm	>50 to <150	'Continuous' shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	≥15% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	160	Medium
3	S3 - OU13	≤50,000 AADT	≤740mm	>50 to <150	'Continuous' shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table <15m and >5m	Dominantly intergranular flow	≥15% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	140	Low

Design Section	Outfall ID	Traffic density	Rainfall depth - annual average	Drainage area ratio	Infiltration method	Unsaturated zone	Flow type	Unsaturated zone clay content	Organic carbon	Unsaturated zone soil pH	Total Score	GW Risk Factor
3	S3 - OU14	≤50,000 AADT	≤740mm	>50 to <150	'Continuous' shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	≥15% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	160	Medium
3	S3 - OU15	≤50,000 AADT	≤740mm	>50 to <150	'Continuous' shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	≥15% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	160	Medium
3	S3-OU15B	≤50,000 AADT	≤740mm	>50 to <150	'Continuous' shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	≥15% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	160	Medium

Design Section	Outfall ID	Traffic density	Rainfall depth - annual average	Drainage area ratio	Infiltration method	Unsaturated zone	Flow type	Unsaturated zone clay content	Organic carbon	Unsaturated zone soil pH	Total Score	GW Risk Factor
3	S3-OU15C	≤50,000 AADT	≤740mm	>50 to <150	'Continuous' shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	≥15% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	160	Medium
3	S3-OU15A & 16	>50,000 to <100,000 AADT	≤740mm	>50 to <150	'Continuous' shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	≥15% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	170	Medium
3	S3-OU20	≤50,000 AADT	≤740mm	>50 to <150	'Continuous' shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	≥15% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	160	Medium

Design Section	Outfall ID	Traffic density	Rainfall depth - annual average	Drainage area ratio	Infiltration method	Unsaturated zone	Flow type	Unsaturated zone clay content	Organic carbon	Unsaturated zone soil pH	Total Score	GW Risk Factor
3	S3-OU21	≥100,000 AADT	≤740mm	>50 to <150	‘Continuous’ shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	≥15% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	180	Medium
3	S3 - OU22	≤50,000 AADT	≤740mm	>50 to <150	‘Continuous’ shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	≥15% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	160	Medium
3	S3-OU23	≤50,000 AADT	≤740mm	>50 to <150	‘Continuous’ shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	≥15% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	160	Medium

Design Section	Outfall ID	Traffic density	Rainfall depth - annual average	Drainage area ratio	Infiltration method	Unsaturated zone	Flow type	Unsaturated zone clay content	Organic carbon	Unsaturated zone soil pH	Total Score	GW Risk Factor
3	S3-OU24	≤50,000 AADT	≤740mm	>50 to <150	'Continuous' shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	≥15% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	160	Medium
3	S3 - OU26	≥100,000 AADT	≤740mm	>50 to <150	'Continuous' shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	≥15% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	180	Medium
3	S3 - OU26A	≥100,000 AADT	≤740mm	>50 to <150	'Continuous' shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table <15m and >5m	Dominantly intergranular flow	≥15% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	160	Medium

Design Section	Outfall ID	Traffic density	Rainfall depth - annual average	Drainage area ratio	Infiltration method	Unsaturated zone	Flow type	Unsaturated zone clay content	Organic carbon	Unsaturated zone soil pH	Total Score	GW Risk Factor
3	S3-OU27	≤50,000 AADT	≤740mm	>50 to <150	'Continuous' shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	≥15% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	160	Medium
3	S3 - OU27A	≤50,000 AADT	≤740mm	>50 to <150	'Continuous' shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	≥15% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	160	Medium
3	S3 - OU28	≤50,000 AADT	≤740mm	>50 to <150	'Continuous' shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	≥15% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	160	Medium

Design Section	Outfall ID	Traffic density	Rainfall depth - annual average	Drainage area ratio	Infiltration method	Unsaturated zone	Flow type	Unsaturated zone clay content	Organic carbon	Unsaturated zone soil pH	Total Score	GW Risk Factor
3	S3-OU29	≤50,000 AADT	≤740mm	>50 to <150	‘Continuous’ shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	≥15% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	160	Medium
3	S3-OU31	≤50,000 AADT	≤740mm	>50 to <150	‘Continuous’ shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	≥15% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	160	Medium
3	S3 - OU32	≤50,000 AADT	≤740mm	>50 to <150	‘Continuous’ shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table <15m and >5m	Dominantly intergranular flow	≥15% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	140	Low
3	S3 - OU33	≤50,000 AADT	≤740mm	>50 to <150	‘Continuous’ shallow	Depth to water table	Dominantly	≥15% clay minerals	<15% to > 1%	pH <8 to >5	140	Low

Design Section	Outfall ID	Traffic density	Rainfall depth - annual average	Drainage area ratio	Infiltration method	Unsaturated zone	Flow type	Unsaturated zone clay content	Organic carbon	Unsaturated zone soil pH	Total Score	GW Risk Factor
					linear (e.g. unlined ditch, swale, grassed channel)	<15m and >5m	intergranular flow		soil organic matter			
IR	IWR1	≤50,000 AADT	≤740mm	>50 to <150	'Continuous' shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table <15m and >5m	Dominantly intergranular flow	≥15% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	140	Low
IR	IWR2	≤50,000 AADT	≤740mm	>50 to <150	'Continuous' shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≥15m or unproductive strata	Dominantly intergranular flow	≥15% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	120	Low
IR	IWR3	≤50,000 AADT	≤740mm	>50 to <150	'Continuous' shallow linear (e.g. unlined ditch,	Depth to water table ≥15m or	Dominantly intergr	≥15% clay minerals	<15% to > 1% soil	pH <8 to >5	120	Low

Design Section	Outfall ID	Traffic density	Rainfall depth - annual average	Drainage area ratio	Infiltration method	Unsaturated zone	Flow type	Unsaturated zone clay content	Organic carbon	Unsaturated zone soil pH	Total Score	GW Risk Factor
					swale, grassed channel)	unproductive strata	anular flow		organic matter			
IR	IWR4	≤50,000 AADT	≤740mm	>50 to <150	‘Continuous’ shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≥15m or unproductive strata	Dominantly intergranular flow	≥15% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	120	Low
IR	IWR5	≤50,000 AADT	≤740mm	>50 to <150	‘Continuous’ shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≥15m or unproductive strata	Dominantly intergranular flow	≥15% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	120	Low
IR	IWR6	≤50,000 AADT	≤740mm	>50 to <150	‘Continuous’ shallow linear (e.g. unlined ditch, swale,	Depth to water table ≥15m or unproductive strata	Dominantly intergranular flow	≥15% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	120	Low

Design Section	Outfall ID	Traffic density	Rainfall depth - annual average	Drainage area ratio	Infiltration method	Unsaturated zone	Flow type	Unsaturated zone clay content	Organic carbon	Unsaturated zone soil pH	Total Score	GW Risk Factor
					grassed channel)							
IR	IWR7	≤50,000 AADT	≤740mm	>50 to <150	‘Continuous’ shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≥15m or unproductive strata	Dominantly intergranular flow	≥15% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	120	Low
1	OU07 & OU07A	>50,000 to <100,000 AADT	≤740mm	>50 to <150	‘Continuous’ shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	≥15% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	170	Medium
1	OU13A +OU14	≥100,000 AADT	≤740mm	>50 to <150	‘Continuous’ shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	≥15% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	180	Medium

Design Section	Outfall ID	Traffic density	Rainfall depth - annual average	Drainage area ratio	Infiltration method	Unsaturated zone	Flow type	Unsaturated zone clay content	Organic carbon	Unsaturated zone soil pH	Total Score	GW Risk Factor
1	OU19C & OU19C1	≤50,000 AADT	≤740mm	>50 to <150	'Continuous' shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	≥15% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	160	Medium
1	OU19, OU19C & OU19C1	≥100,000 AADT	≤740mm	>50 to <150	'Continuous' shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	≥15% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	180	Medium
2	OU9 + OU10	≥100,000 AADT	≤740mm	>50 to <150	'Continuous' shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	<15% to > 1% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	185	Medium

Design Section	Outfall ID	Traffic density	Rainfall depth - annual average	Drainage area ratio	Infiltration method	Unsaturated zone	Flow type	Unsaturated zone clay content	Organic carbon	Unsaturated zone soil pH	Total Score	GW Risk Factor
2	OU9, 0U9A + OU10	≥100,000 AADT	≤740mm	>50 to <150	'Continuous' shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	<15% to > 1% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	185	Medium
2	OU15A + OU14	≥100,000 AADT	≤740mm	>50 to <150	'Continuous' shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table <15m and >5m	Dominantly intergranular flow	<15% to > 1% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	165	Medium
2	OU15A + OU14 + OU15E	≥100,000 AADT	≤740mm	>50 to <150	'Continuous' shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	<15% to > 1% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	185	Medium

Design Section	Outfall ID	Traffic density	Rainfall depth - annual average	Drainage area ratio	Infiltration method	Unsaturated zone	Flow type	Unsaturated zone clay content	Organic carbon	Unsaturated zone soil pH	Total Score	GW Risk Factor
2	OU15C + OU15D	≥100,000 AADT	≤740mm	>50 to <150	‘Continuous’ shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	≥15% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	180	Medium
2	OU15H + OU26	≥100,000 AADT	≤740mm	>50 to <150	‘Continuous’ shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	<15% to > 1% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	185	Medium
3	OU06 & OU7A	≥100,000 AADT	≤740mm	>50 to <150	‘Continuous’ shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	≥15% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	180	Medium

Design Section	Outfall ID	Traffic density	Rainfall depth - annual average	Drainage area ratio	Infiltration method	Unsaturated zone	Flow type	Unsaturated zone clay content	Organic carbon	Unsaturated zone soil pH	Total Score	GW Risk Factor
3	OU14, OU06 & OU7A	≥100,000 AADT	≤740mm	>50 to <150	'Continuous' shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	≥15% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	180	Medium
3	OU15, OU15B, OU15C	≥100,000 AADT	≤740mm	>50 to <150	'Continuous' shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	≥15% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	180	Medium
3	OU21, OU22, OU23 & OU24	≥100,000 AADT	≤740mm	>50 to <150	'Continuous' shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	≥15% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	180	Medium

Design Section	Outfall ID	Traffic density	Rainfall depth - annual average	Drainage area ratio	Infiltration method	Unsaturated zone	Flow type	Unsaturated zone clay content	Organic carbon	Unsaturated zone soil pH	Total Score	GW Risk Factor
3	OU26, OU26A	≥100,000 AADT	≤740mm	>50 to <150	'Continuous' shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	≥15% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	180	Medium
3	OU27, OU27A & OU28	≤50,000 AADT	≤740mm	>50 to <150	'Continuous' shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≤5m	Dominantly intergranular flow	≥15% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	160	Medium
IR	IWR1-IWR7	≤50,000 AADT	≤740mm	>50 to <150	'Continuous' shallow linear (e.g. unlined ditch, swale, grassed channel)	Depth to water table ≥15m or unproductive strata	Dominantly intergranular flow	≥15% clay minerals	<15% to > 1% soil organic matter	pH <8 to >5	120	Low

Table H.2 Further water quality assessment at outfall locations

Water quality standard (formatting demonstrates exceedance)	Cu (ug/l)	Zn (ug/l)
EQS	1	10.9
DWS	2000	5000
EQS MBAT	12.44	25.75

Green indicates no failure of water quality standards.

Location		Receiving Watercourse	Q95	SUDS Treatment Train	Treatment Efficiency %			Further Assessment (WQ Screen)			
Design Section	Outfall ID							Pre-Mitigation Run-off Concentration (ug/L)		Post-Mitigation Run-off Concentration (ug/L)	
					Cu	Zn	TSS	Cu	Zn	Cu	Zn
1	S1 - OU07	Ordinary Watercourse 2	0.0011	Passive Treatment	0	0	0	0.53	1.19	0.53	1.19
1	S1 - OU07A	Ordinary Watercourse 2	0.0011	Filter Drain (27.47%), Underground Storage Units (50%), Attenuation Pond	40	38	66	0.41	0.95	0.25	0.59
1	S1 - OU14	Ordinary Watercourse 28	0.0011	Passive Treatment	0	0	0	0.45	1.5	0.45	1.5
1	S1 - OU13A	Ordinary Watercourse 28	0.0011	Online Storage & Vegetated Ditch	15	15	25	0.1	0.23	0.09	0.2

Location		Receiving Watercourse	Q95	SUDS Treatment Train	Treatment Efficiency %			Further Assessment (WQ Screen)			
Design Section	Outfall ID							Pre-Mitigation Run-off Concentration (ug/L)		Post-Mitigation Run-off Concentration (ug/L)	
					Cu	Zn	TSS	Cu	Zn	Cu	Zn
1	S1 - OU18	Ordinary Watercourse 31 then River Ter	0.0011	Filter Drain (50%) & Attenuation Pond	40	45	72	1.39	4.62	0.83	2.54
1	S1 - OU19	Ordinary Watercourse 7	0.0011	Cascading Attenuation Pond with two Basins	40	61	84	1.11	3.67	0.4	1.8
1	S1 - OU19C	Ordinary Watercourse 7	0.0011	Attenuation Pond	40	30	60	0.25	0.54	0.15	0.38
1	S1 - OU19C1	Ordinary Watercourse 7	0.0011	Attenuation Pond	40	30	60	0.24	0.53	0.14	0.37
1	S1 - OU23 (+ 23C, 23D, 24A)	Ordinary Watercourse 32	0.0011	Filter Drain (17.96%) & Cascading Attenuation Pond with three Basins	80	70	95	3.32	11.08	0.66	3.32
1	S1 - OU23C	Ordinary Watercourse 32	0.0011	Attenuation Pond	40	30	60	0.25	0.55	0.15	0.38
1	S1 - OU23D	Ordinary Watercourse 32	0.0011	Filter Drain (12.93%) & Attenuation Pond	40	34	63	0.48	1.07	0.29	0.7

Location		Receiving Watercourse	Q95	SUDS Treatment Train	Treatment Efficiency %			Further Assessment (WQ Screen)			
								Pre-Mitigation Run-off Concentration (ug/L)		Post-Mitigation Run-off Concentration (ug/L)	
Design Section	Outfall ID				Cu	Zn	TSS	Cu	Zn	Cu	Zn
1	S1 - OU24A	Ordinary Watercourse 32	0.0011	Vegetated Ditch (90%) & Attenuation Pond	48	39	69	0.35	0.78	0.18	0.47
1	S1 - OU24B	Ordinary Watercourse 32	0.0011	Filter Drain (2.98%), Vegetated Ditch (75%), Attenuation Pond	46	38	68	0.44	0.98	0.24	0.6
2	S2 - OU03	Ordinary Watercourse 9	0.0011	Online Storage	0	0	0	0.44	1.45	0.44	1.45
2	S2 - OU08	Ordinary Watercourse 9a then River Blackwater	0.0011	Filter Drain (54%) & Online Storage	0	24	32	1.92	6.39	1.92	4.86
2	S2 - OU09	Ordinary Watercourse 10	0.0011	Filter Drain (30%) & Cascading Attenuation Pond with two Basins	64	57	86	1.68	5.61	0.61	2.41
2	S2 - OU09A	Ordinary Watercourse 10	0.0011	Filter Drain (53%) & Online Storage	0	23	31	0.32	1.05	0.32	0.81

Location		Receiving Watercourse	Q95	SUDS Treatment Train	Treatment Efficiency %			Further Assessment (WQ Screen)			
Design Section	Outfall ID							Pre-Mitigation Run-off Concentration (ug/L)		Post-Mitigation Run-off Concentration (ug/L)	
					Cu	Zn	TSS	Cu	Zn	Cu	Zn
2	S2 - OU10	Ordinary Watercourse 10	0.0011	Filter Drain (20%) & Attenuation Pond & Vegetated ditch	49	45	73	0.41	0.91	0.21	0.5
2	S2 - OU11	Ordinary Watercourse 11	0.0011	Attenuation Pond	40	30	60	0.39	0.86	0.23	0.6
2	S2 - OU14	Ordinary Watercourse 12a	0.0011	Filter Drain (22%) & Attenuation Pond	40	36	65	0.41	0.92	0.25	0.59
2	S2 - OU15A	Ordinary Watercourse 12a	0.0011	Filter Drain (11%) & Cascading Attenuation Pond with two Basins	64	53	84	1.15	2.67	0.41	1.25
2	S2 - OU15C	Ordinary Watercourse 13	0.0011	Filter Drain (27%) & Cascading Attenuation Pond with two Basins	64	56	86	1.95	6.49	0.7	2.86
2	S2 - OU15C1	Ordinary Watercourse 15a	0.0011	Filter Drain (18%) & Attenuation Pond	40	35	64	0.44	1.45	0.27	0.96
2	S2 - OU15D	Ordinary Watercourse 13	0.0011	Attenuation Pond	40	30	60	0.15	0.33	0.09	0.23

Location		Receiving Watercourse	Q95	SUDS Treatment Train	Treatment Efficiency %			Further Assessment (WQ Screen)			
Design Section	Outfall ID							Pre-Mitigation Run-off Concentration (ug/L)		Post-Mitigation Run-off Concentration (ug/L)	
					Cu	Zn	TSS	Cu	Zn	Cu	Zn
2	S2 - OU15E	Ordinary Watercourse 12a	0.0011	Attenuation Pond	40	30	60	0.27	0.59	0.16	0.42
2	S2 - OU26	Ordinary Watercourse 17	0.0011	Passive Treatment	0	0	0	0.32	0.71	0.32	0.71
2	S2 - OU27	Unnamed Ditch	0.0011	Online Storage	0	0	0	0.00	0.00	0.00	0.00
3	S3 - OU02	Ordinary Watercourse 21 then River Blackwater	0.0011	Filter Drain (54.89%) & Cascading Attenuation Pond with two Basins	64	63	88	2.09	6.95	0.75	2.57
3	S3 - OU03	Ordinary Watercourse 18	0.0011	Attenuation Pond	40	30	60	0.19	0.42	0.11	0.29
3	S3 - OU04	Ordinary Watercourse 21	0.0011	Attenuation Pond	40	30	60	0.12	0.26	0.07	0.18
3	S3 - OU06	Ordinary Watercourse 21a	0.0011	Filter Drain (100%)	0	45	60	0.02	0.05	0.02	0.03
3	S3 - OU07A	Ordinary Watercourse 21a	0.0011	Filter Drain (100%)	0	45	60	0.06	0.12	0.06	0.07

Location		Receiving Watercourse	Q95	SUDS Treatment Train	Treatment Efficiency %			Further Assessment (WQ Screen)			
Design Section	Outfall ID							Pre-Mitigation Run-off Concentration (ug/L)		Post-Mitigation Run-off Concentration (ug/L)	
					Cu	Zn	TSS	Cu	Zn	Cu	Zn
3	S3 - OU08B&8D	Unnamed Ditch	0.0011	Filter Drain (29.80%) & Attenuation Pond	40	39	67	0.18	0.41	0.11	0.25
3	S3 - OU08C	Unnamed Ditch	0.0011	Vegetated Ditch (47.06%) & Online Storage	40	44	71	0.04	0.08	0.02	0.04
3	S3 - OU08E	Unnamed Ditch	0.0011	Attenuation Pond	40	30	60	0.08	0.18	0.05	0.12
3	S3 - OU13	Ordinary Watercourse 35	0.0011	Attenuation Pond	40	30	60	0.06	0.14	0.04	0.1
3	S3 - OU14	Ordinary Watercourse 21a	0.0011	Attenuation Pond	40	30	60	0.05	0.1	0.03	0.07
3	S3 - OU15	Ordinary Watercourse 26	0.0011	Passive Treatment	0	0	0	0.23	0.51	0.23	0.51
3	S3 - OU15B	Ordinary Watercourse 26	0.0011	Attenuation Pond	40	30	60	0.09	0.19	0.05	0.13
3	S3 - OU15C	Ordinary Watercourse 26	0.0011	Attenuation Pond	40	30	60	0.08	0.18	0.05	0.13
3	S3 - OU16 & OU15A	Ordinary Watercourse 36	0.0011	Filter Drain (32.98%) & Attenuation Pond	40	40	67	1.46	4.87	0.88	2.92

Location		Receiving Watercourse	Q95	SUDS Treatment Train	Treatment Efficiency %			Further Assessment (WQ Screen)			
Design Section	Outfall ID							Pre-Mitigation Run-off Concentration (ug/L)		Post-Mitigation Run-off Concentration (ug/L)	
					Cu	Zn	TSS	Cu	Zn	Cu	Zn
3	S3 - OU20	Unnamed Ditch	0.0011	Swale	50	50	80	0.03	0.06	0.01	0.03
3	S3 - OU21	Ordinary Watercourse 23	0.0011	Cascading Attenuation Pond with two basins	64	51	84	1.35	4.46	0.49	2.19
3	S3 - OU22	Ordinary Watercourse 23	0.0011	Attenuation Pond	40	30	60	0.19	0.42	0.11	0.29
3	S3 - OU23	Ordinary Watercourse 23	0.0011	Attenuation Pond	40	30	60	0.23	0.51	0.14	0.35
3	S3 - OU24	Ordinary Watercourse 23	0.0011	Filter Drain (23.44%) & Attenuation Pond	40	37	65	0.41	0.92	0.25	0.58
3	S3 - OU26	Ordinary Watercourse 37	0.0011	Filter Drain (42.56%) & Attenuation Pond	40	43	70	1.01	3.32	0.6	1.89
3	S3 - OU26A	Ordinary Watercourse 37	0.0011	Filter Drain (85.95%) & Cascading Attenuation Pond with two basins & Vegetated outfall	69	74	94	1.78	5.91	0.55	1.54
3	S3 - OU27	Ordinary Watercourse 40	0.0011	Attenuation Pond	40	30	60	0.13	0.29	0.08	0.2

Location		Receiving Watercourse	Q95	SUDS Treatment Train	Treatment Efficiency %			Further Assessment (WQ Screen)			
Design Section	Outfall ID							Pre-Mitigation Run-off Concentration (ug/L)		Post-Mitigation Run-off Concentration (ug/L)	
					Cu	Zn	TSS	Cu	Zn	Cu	Zn
3	S3 - OU27A	Ordinary Watercourse 39	0.0011	Swale	50	50	80	0.04	0.09	0.02	0.05
3	S3 - OU28	Ordinary Watercourse 39	0.0011	Swale	50	50	80	0.09	0.2	0.04	0.1
3	S3 - OU29	Unnamed Ditch	0.0011	Attenuation Pond	40	30	60	0.21	0.47	0.13	0.33
3	S3 - OU31	Unnamed Ditch	0.0011	Attenuation Pond	40	30	60	0.18	0.39	0.11	0.27
3	S3 - OU32	Ordinary Watercourse 41	0.0011	Attenuation Pond	40	30	60	0.24	0.54	0.15	0.38
3	S3 - OU33	Ordinary Watercourse 42	0.0011	Attenuation Pond	40	30	60	0.87	1.95	0.52	1.37
Inworth Rd	IWR1	Existing Inworth Rd drainage but suspected to ultimately be Watercourse 34	0.0011	Ditch (No Treatment)	0	0	0	0.05	0.11	0.05	0.11
Inworth Rd	IWR2	Watercourse 34	0.0011	Attenuation Pond	40	30	60	0.17	0.37	0.1	0.26
Inworth Rd	IWR3	Watercourse 34	0.0011	Attenuation Pond	40	30	60	0.2	0.44	0.12	0.31

Location		Receiving Watercourse	Q95	SUDS Treatment Train	Treatment Efficiency %			Further Assessment (WQ Screen)			
Design Section	Outfall ID							Pre-Mitigation Run-off Concentration (ug/L)		Post-Mitigation Run-off Concentration (ug/L)	
					Cu	Zn	TSS	Cu	Zn	Cu	Zn
Inworth Rd	IWR4	Watercourse 34	0.0011	Ditch (No Treatment)	0	0	0	0.2	0.44	0.2	0.44
Inworth Rd	IWR5	Watercourse 34C	0.0011	Attenuation Pond	40	30	60	0.08	0.18	0.05	0.13
Inworth Rd	IWR6	Watercourse 34C	0.0011	Ditch (No Treatment)	0	0	0	0.08	0.18	0.08	0.18
Inworth Rd	IWR7	Watercourse 34C	0.0011	Attenuation Pond	40	30	60	0.05	0.12	0.03	0.08
1	S1 - OU07, OU7A	Ordinary Watercourse 2	0.0011	Passive treatment, Filter Drain and Attenuation Pond	14	13	23	0.86	2	0.74	1.74
1	S1 - OU14, OU13A	Ordinary Watercourse 28	0.0011	Passive treatment and Vegetated Ditch	4	4	7	0.61	2.02	0.59	1.94
1	S1 - OU19C, OU19C1	Ordinary Watercourse 7	0.0011	Attenuation Ponds	40	30	60	0.42	0.93	0.25	0.65
1	S1 - OU19C, OU19C1, OU19	Ordinary Watercourse 7	0.0011	Double Attenuation Pond and Attenuation Ponds	53	42	73	1.58	5.25	0.74	3.05

Location		Receiving Watercourse	Q95	SUDS Treatment Train	Treatment Efficiency %			Further Assessment (WQ Screen)			
Design Section	Outfall ID							Pre-Mitigation Run-off Concentration (ug/L)		Post-Mitigation Run-off Concentration (ug/L)	
					Cu	Zn	TSS	Cu	Zn	Cu	Zn
2	S2 - OU9 + OU10	Ordinary Watercourse 10	0.0011	Filter Drains, Attenuation Pond, Vegetated Ditch	59	54	83	2.03	6.76	0.83	3.11
2	S2 - OU9, OU9A + OU10	Ordinary Watercourse 10	0.0011	Filter Drains, Online Storage, Attenuation Pond, Vegetated Ditch	55	52	79	2.12	7.06	0.95	3.39
2	S2 - OU15A + OU14	Ordinary Watercourse 12	0.0011	Filter Drains & Attenuation Ponds	58	49	80	2.33	7.78	0.98	3.97
2	S2 - OU15A + OU14 + OU15E	Ordinary Watercourse 12	0.0011	Filter Drains & Attenuation Ponds	56	47	78	2.48	8.27	1.09	4.38
2	S2 - OU15C + OU15D	Ordinary Watercourse 13	0.0011	Filter Drains & Attenuation Ponds	62	54	84	2.04	6.79	0.77	3.13
2	S2 - OU15H + OU26	Ordinary Watercourse 17	0.0011	Attenuation Pond and Online Storage	22	16	33	1.24	4.11	0.96	3.45
3	S3 - OU06 & OU7A	Ordinary Watercourse 21a	0.0011	Filter Drain	0	45	60	0.16	0.52	0.16	0.28

Location		Receiving Watercourse	Q95	SUDS Treatment Train	Treatment Efficiency %			Further Assessment (WQ Screen)			
Design Section	Outfall ID							Pre-Mitigation Run-off Concentration (ug/L)		Post-Mitigation Run-off Concentration (ug/L)	
					Cu	Zn	TSS	Cu	Zn	Cu	Zn
3	S3 - OU14, OU06 & OU7A	Ordinary Watercourse 21a	0.0011	Filter Drains & Attenuation Pond	11	43	60	0.24	0.79	0.22	0.45
3	S3 - OU15, OU15B, OU15C	Ordinary Watercourse 26	0.0011	Passive Treatment & Attenuation Ponds	15	11	23	0.72	2.37	0.61	2.11
3	S3 - OU21, OU22, OU23 & OU24	Ordinary Watercourse 23	0.0011	Filter Drains & Attenuation Ponds	52	40	70	2.02	6.7	0.97	4.02
3	S3 - OU26, OU26A	Ordinary Watercourse 37	0.0011	Filter Drains, Attenuation Ponds & Vegetated outfall	60	65	87	2.15	7.14	0.86	2.5
3	S3 - OU27, & OU28	Ordinary Watercourse 39	0.0011	Swale and Attenuation Ponds	43	37	67	0.20	0.45	0.12	0.28
Inworth Rd	IWR1-IWR7	Ordinary Watercourse 34	0.0011	No Treatment & Attenuation Ponds	24	18	36	0.57	1.27	0.43	1.04