A12 Chelmsford to A120 widening scheme
TR010060

6.1 ENVIRONMENTAL STATEMENT
CHAPTER 14 ROAD DRAINAGE AND THE WATER ENVIRONMENT

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ENVIRONMENTAL STATEMENT
CHAPTER 14 ROAD DRAINAGE AND THE WATER ENVIRONMENT

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14.1 Topic introduction

14.1.1 This chapter presents the information required by the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (as amended) to be provided in the Environmental Statement for the proposed A12 Chelmsford to A120 widening scheme (the proposed scheme) in respect of road drainage and the water environment (RDWE).

14.1.2 This chapter presents the results of an assessment of likely significant effects of the construction and operation of the proposed scheme on RDWE. It is based on 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) augmented as required. The spatial scope of the assessment has included features of the water environment within at least 1km of the Order Limits of the proposed scheme (see Section 14.7 of this chapter). For certain matters, for example flood risk, the study area has increased to fully assess the impact of the proposed scheme.

14.1.3 The RDWE, as assessed by this chapter, includes the following matters:

- Surface water:
  - Water quality (routine runoff and spillage)
  - Water resources
  - Hydromorphology
- Groundwater:
  - Water quality (routine runoff and spillage)
  - Groundwater levels and flows
  - Groundwater dependent terrestrial ecosystems (GWDTEs)
  - Groundwater abstractions
- Flood risk (all sources) and surface water drainage

14.1.4 This chapter is supported by the following figures [TR010060/APP/6.2]:

- Figure 14.1 Key Water Environment Features
- Figure 14.2 Aquifer Designations
- Figure 14.3 Potential Groundwater Receptors
- Figure 14.4 Existing Fluvial Flood Risk
- Figure 14.5 Existing Surface Water Flood Risk
- Figure 14.6 Existing Groundwater Flood Risk

14.1.5 This chapter is supported by the following appendices [TR010060/APP/6.3]:

- Appendix 14.1 Water Quality Assessment Report (WQAR)
- Appendix 14.2 Water Environment Regulations (WFD Regulations) Compliance Assessment
- Appendix 14.3 Hydromorphology Assessment
- Appendix 14.4 Groundwater Assessment
- Appendix 14.5 Flood Risk Assessment (FRA)
- Appendix 14.6 Surface Water Drainage Strategy

14.1.6 These appendices contain the detailed information, assessment and conclusions that support the assessment of likely significant effects reported in this chapter.

14.2 Competent expert evidence

14.2.1 The assessment has been undertaken and reported by a team of suitably qualified RDWE specialists. The competent expert responsible for the assessment is a Senior Associate Director qualified as a Chartered Water and Environmental Manager (C.WEM), Member of the Chartered Institution of Water and Environmental Management (MCIWEM), BA and MSc (Eng). They have over 23 years' experience, nine of which have been undertaking RDWE assessments for major infrastructure and linear projects, including highways, for which the process of EIA (Environmental Impact Assessment) has been required.

14.3 Stakeholder engagement

14.3.1 Table 14.1 provides a summary of the key stakeholder feedback and key requirements from the Planning Inspectorate as identified within the Scoping Opinion (Planning Inspectorate, 2021) relevant to the assessment of RDWE.

Table 14.1 Key Scoping Opinion feedback for road drainage and the water environment

Stakeholder	Comment	Response
Planning Inspectorate	The Environmental Statement should provide robust justification for the chosen 1km study area, and the Applicant should make effort to consult with the relevant consultation bodies regarding the study area of the assessment.	The Environmental Statement fully considers potential impacts even if they extend beyond the 1km extent as stated in Section 14.7 of this chapter.
Flood risk		
Planning Inspectorate	The Planning Inspectorate does not agree that flood risks from canals can be scoped out of the Environmental Statement due to the presence of the Chelmer and Blackwater Navigation within the study area.	The FRA (Appendix 14.5 [TR010060/APP/6.3]) includes the assessment of potential risk from the Chelmer and Blackwater Navigation.
	The Planning Inspectorate agrees that flooding due to reservoir failure may be scoped out of detailed assessment on the basis that such reservoirs are subject to a monitoring and maintenance regime and the probability of an event is low.	This matter has been scoped out of the assessment.
	The Planning Inspectorate agrees that coastal flooding can be scoped out of the Environmental Statement as the proposed scheme is not located near the coast, and none of the watercourses within the study area are tidal.	This matter has been scoped out of the assessment.
	The Environmental Statement should set out where floodplain compensation land will be located, how this location was determined, and effort should be made to agree the location of floodplain compensation land with the relevant statutory consultation bodies. The Environmental Statement should also include a figure(s) depicting floodplain compensation land.	The FRA (Appendix 14.5 [TR010060/APP/6.3]) includes plans and descriptions of the proposed mitigation (including floodplain compensation) that has informed the assessment of impacts reported in the Environmental Statement. Discussions have been held with regulators throughout the development of the Environmental Statement to present, discuss and seek acceptance of proposed mitigation measures.

Stakeholder	Comment	Response
	Details of flood compensation areas, upgrading of structures to improve conveyance, and improved defences to prevent any increases in flood risk should all be included within the Environmental Statement.	The Environmental Statement is supported by the FRA (Appendix 14.5 [TR010060/APP/6.3]) which provides details of all the flood risk mitigation measures, including floodplain compensation, to ensure no significant increase in flood risk as a result of the proposed scheme.
Anglian Water	Consideration should be given to all potential sources of flooding, including sewer flooding, as part of the Environmental Statement and related flood risk assessment. Suggest that reference is made to any relevant records in Anglian Water's sewer flooding register as well as other information relating to flood risk as outlined in the report.	The FRA (Appendix 14.5 [TR010060/APP/6.3]) considers the interaction of the proposed scheme with all sources of flooding.
Environment Agency	An Environmental Permit for Flood Risk Activities may be required for works in, under, over, or within 8m of a fluvial Main River, and from any flood defence structure or culvert.	Noted, and applications for such consents (if disapplication not sought) would be made when the proposed scheme design is sufficiently detailed, which would be prior to the relevant construction.
	Revised fluvial climate change allowances and updated guidance for use were published on 20 July 2021.	The updated climate change allowances as published in July 2021 (Environment Agency, 2021d) have been applied as part of the hydraulic modelling undertaken to inform the assessment of flood risk effects of the proposed scheme. Detailed results are included in the FRA (Appendix 14.5 [TR010060/APP/6.3]).
Drainage		
Planning Inspectorate	Further information regarding the ‘desk-based assessment that was undertaken of the existing drainage network’ should be included within, or appended to, the Environmental Statement.	An assessment of the existing drainage network has been undertaken and included in the Surface Water Drainage Strategy (Appendix 14.6 [TR010060/APP/6.3]).

Stakeholder	Comment	Response
	The Environmental Statement should include full details of all existing drainage infrastructure that is to be impacted / demolished and the new drainage infrastructure that is to be constructed. A figure(s) should be provided within the Environmental Statement that presents the locations and changes to be made to the drainage infrastructure.	The Surface Water Drainage Strategy (Appendix 14.6 [TR010060/APP/6.3]) describes the drainage design principles and operation of the existing and proposed drainage catchments. The drainage layout plans provided in Annex A of the Surface Water Drainage Strategy details the existing and proposed drainage catchments. The details showing the proposed drainage network arrangement including potential impact to the existing drainage infrastructure will be developed through detailed design process (post-DCO).
	The Environment Agency in their consultation response raised concern with the existing drainage infrastructure potentially resulting in water quality declines in watercourses once they cross the existing A12. The Environmental Statement should address this matter and effort should be made to consult on the drainage infrastructure with the Environment Agency and other relevant consultation bodies.	The Environmental Statement includes an assessment of the impact of the proposed scheme on the water quality of receiving water bodies in Section 14.11 of this chapter. The detail supporting this assessment is included in the WQAR (Appendix 14.1 [TR010060/APP/6.3]). Liaison with the Environment Agency and Essex County Council is ongoing regarding this matter.
	The Environmental Scoping Report states that historical map analysis indicates little change to drainage ditches since 1876. The Planning Inspectorate notes that in places within the study area of the proposed scheme there have been considerable changes to field boundaries and drainage ditches since the late 19th century, and the Environmental Statement should have more effective cross-referencing between historic map regression undertaken as part of the heritage assessment chapter and the flood, drainage and water quality section.	Historic map regression has informed Chapter 7: Cultural heritage, of the Environmental Statement [TR010060/APP/6.1]. High-level analysis of the historical changes to drainage channels has been carried out and described in the Hydromorphology Assessment (Appendix 14.3 [TR010060/APP/6.3]).

Stakeholder	Comment	Response
	The Environmental Statement should include a detailed Surface Water Drainage Strategy including the locations and dimensions of any sustainable drainage systems (SuDS). The Environmental Statement should also include a figure(s) depicting the locations of SuDS.	The Surface Water Drainage Strategy (Appendix 14.6 [TR010060/APP/6.3]) includes details of proposed SuDS. The SuDS inform the assessment of impacts documented in the FRA (Appendix 14.5 [TR010060/APP/6.3]) and the Environmental Statement.
	The Environmental Statement should assess and state any potential impacts that the construction and operation of the proposed scheme could have on existing agricultural drainage systems, and how these impacts could affect the surrounding agricultural land.	The operational impact of the proposed scheme on agricultural drainage has been considered as part of the Water Management Plan within the first iteration Environmental Management Plan [TR010060/APP/6.5]), with any impacts included within the Environmental Statement.
Essex County Council	As the Lead Local Flood Authority (LLFA), Essex County Council would expect a detailed Surface Water Drainage Strategy including SuDS, water quality, and a SuDS adoption and maintenance plan to be submitted alongside the application for this scheme. In providing advice as the LLFA, Essex County Council would look to ensure sustainable drainage proposals comply with the required standards as set out in the following documents: • Non-statutory technical standards for sustainable drainage systems (Department for Environment, Food and Rural Affairs (Defra), 2015) • Essex County Council's adopted Sustainable Drainage Systems Design Guide (2020) • The CIRIA SuDS Manual (C753) (2015a) • BS 8582 Code of practice for surface water management for development sites (2013)	The Surface Water Drainage Strategy (Appendix 14.6 [TR010060/APP/6.3]) supports the FRA (Appendix 14.5 [TR010060/APP/6.3]) and Environmental Statement. Sustainable drainage has been designed in accordance with DMRB standards. Other guidance has been given due consideration where it is appropriate. The Surface Water Drainage Strategy discusses the maintenance requirements associated with the various highway drainage elements. Adoption plans will be developed through the detailed design process (post-DCO).

Stakeholder	Comment	Response
Anglian Water	At this stage it is unclear whether there is a requirement for a connection(s) to the public sewerage network for the proposed scheme (including during the construction phase). Anglian Water welcome the intention to have further consultation with the project team and other relevant bodies in respect of the drainage strategy for the proposed scheme.	Liaison has been undertaken with regulators throughout the development of the Environmental Statement (see Table 14.3). It is anticipated that connections for water supply would be required, while wastewater is uncertain at this time subject to local constraints.
Groundwater		
Planning Inspectorate	The Environmental Scoping Report states that continuous groundwater monitoring, initially for a 12-month period, is to be undertaken in a number of boreholes across the area of the proposed scheme. Monitoring data should be provided with the Environmental Statement.	Data plots of the available data to September 2021 are presented in Section 2 of Appendix 14.4, of the Environmental Statement [TR010060/APP/6.3].
Planning Inspectorate	Analysis of existing groundwater abstraction and potential future changes to this in the Environmental Statement must be adequately cross-referenced to the geoarchaeological section of the cultural heritage chapter, in addition to soils and geology.	The RDWE chapter cross references to Chapter 7: Cultural heritage, of the Environmental Statement [TR010060/APP/6.1]. The assessment of effects is included in Section 4 of Appendix 14.4 [TR010060/APP/6.3].
Planning Inspectorate	The potential location of piling or dewatering work should be identified and presented within the Environmental Statement.	An assessment of the locations which could require construction dewatering are included in Section 3 of Appendix 14.4 [TR010060/APP/6.3]. Details on groundwater flow disruptions as a result of sheet piles and bored piles is included in the FRA (Appendix 14.5 [TR010060/APP/6.3]). Plans of the pile locations are presented in Figure 12.3 [TR010060/APP/6.2].

Stakeholder	Comment	Response
Environment Agency	Reference should be made to the Environment Agency's groundwater protection guidance in relation to controlled discharges.	The proposed scheme does not include infiltration or discharge of runoff to ground. Consideration has been given to discharge from highway drainage outfalls to low-flow streams which have been assessed and are included with the WQAR (Appendix 14.1 [TR010060/APP/6.3]). Reference to the groundwater protection guidance document has been made in the standard construction mitigation measures (Section 14.10 of this chapter).
Environment Agency	In terms of value to the owners, a domestic groundwater abstraction will be of very high value where it is the sole source of drinking water; risk assessments should reflect this.	It is a standard approach in EIA assessments to distinguish in terms of value between a public water supply borehole providing water to thousands of properties, and a borehole supplying water to one property. While the value of the small private abstractions would be lower than a public supply borehole, the assessment identifies whether there would be a significant impact to the individual boreholes, providing details of the mitigation required. This is reflected in the definitions provided in Table 14.10 (in Section 14.8 of this chapter).
Water Environment (Water Framework Directive) Regulations (WFD Regulations)		
Environment Agency	We are satisfied that risks to the water environment have been identified from construction and operation. However, some of the conclusions seem a little early to make. The table states no risk to status for all risks, and that 'compliance with the WFD would be achieved'. More detailed assessment is required before this can be confirmed and assessment at element level for WFD is required as mentioned above.	Compliance has been assessed in the detailed Appendix 14.2 Water Environment Regulations (WFD Regulations) Compliance Assessment ([TR010060/APP/6.3]).

Stakeholder	Comment	Response
	We are also currently generally satisfied in respect of how the Preliminary Environmental Information Report (PEIR) (Highways England, 2021b) has specifically addressed Water Framework Directive (WFD) issues. We would however highlight that although the overall aim of projects should be 'no deterioration of overall status in watercourses', the WFD additionally requires that there is no deterioration in the individual elements. This needs to be acknowledged and it should be ensured that the individual elements are also assessed and considered during the detailed design process. We have also reviewed the updated Preliminary WFD Assessment as referred to in Chapter 14 of the PEIR. We note that WFD requirements to prevent the deterioration of waterbody class are mentioned. It should be acknowledged that these 'no deterioration' requirements also apply independently to each of the elements that come together to form the waterbody classification. (See the Weser Ruling by the European Court of Justice in 2015).	Each water quality element has been assessed in the detailed Appendix 14.2 Water Environment Regulations (WFD Regulations) Compliance Assessment [TR010060/APP/6.3].

Stakeholder	Comment	Response
Highways England Water Risk Assessment Tool		
Environment Agency	Assumptions and limitations of using the HEWRAT method will need to be clearly identified. Reference should also be made to the Essex County Council SuDS Design Guide (2020) (and the SuDS guidance at https://www.susdrain.org) which provides guidance on water quality. It should be ensured that any opportunities to provide additional water quality treatment infrastructure beyond HEWRAT outputs are fully considered.	The assessment of water quality effects has been based upon DMRB LA 113 (Highways England, 2020a) and assessed using the Highways England Water Risk Assessment Tool (HEWRAT). Section 2.6 of the WQAR (Appendix 14.1 [TR010060/APP/6.3]) includes the assumptions and limitations of the HEWRAT assessment. Local Planning Policy is referred to in Section 14.4 of this chapter. Opportunities for water quality enhancements have been explored as the design has developed. Attenuation ponds provide an enhancement for those catchments where the HEWRAT assessments determined that mitigation is not required. The scheme would also provide treatment for some existing drainage catchments where none currently exists thus providing a betterment compared to the exiting situation.

Stakeholder	Comment	Response
Essex County Council	Concerns have been flagged on the use of HEWRAT which is not considered to give suitable consideration to the potential long-term cumulative impact of development. Essex County Council ask that a comparative assessment based on the CIRIA Simple Index Approach for water treatment is also investigated.	The assessment of water quality impacts has been based upon the methodology provided in DMRB LA 113 (Highways England, 2020a) and assessed using HEWRAT. This methodology is bespoke to each individual watercourse and based upon site-specific characteristics and considered the most appropriate for a scheme of this nature. DMRB LA 113 aligns with the requirements of the Water Environment (Water Framework Directive) Regulations (England and Wales) 2017, i.e. published Environmental Quality Standards (EQS) which consider the long-term impact upon water quality (annual average concentrations). HEWRAT also provides assessment related to the intermittent nature of road runoff which has been developed through research undertaken by National Highways (previously Highways England and Highways Agency) with the Environment Agency. A cumulative assessment has been undertaken using HEWRAT for outfalls in accordance with DMRB LA 113 standards and reported in the WQAR (Appendix 14.1 [TR010060/APP/6.3]). It is not deemed within the remit of the proposed scheme to assess quantitatively the water quality impacts of discharges outside of National Highways' control, other than where these outfalls directly receive highway runoff from the proposed scheme. It is assumed that all other discharges will be subject to the Environmental Permitting (England and Wales) Regulations 2016 (unless exempt) and any conditions associated with such permits or planning conditions via these mechanisms would themselves not cause pollution. Any discharges not subject to environmental permitting are beyond the remit of reasonable and proportionate assessment.

Stakeholder	Comment	Response
		The CIRIA Simple Index Approach is based primarily upon development and land use type. This methodology defers to DMRB (HA 2009, superseded by LA 113) for trunk roads and motorways. The Simple Index Approach does not consider the characteristics of the receiving watercourse, the nature of the drainage catchment, nor the legal EQS requirements. The Simple Index Approach does not consider the potential long-term, short-term or cumulative impact of development. It is therefore not deemed to be appropriate for assessing the proposed scheme.
Environment Agency	As well as licensed surface water abstractions there could possibly also be *de minimus* surface water abstractions (<20m^3/d). Identifying these is not straightforward. It is possible, given the nature of the scheme, that landowners would raise this with the developer, but this should be further considered.	It is noted, regarding the licensed surface water abstractions. Landowner questionnaires will be prepared by the project team during detailed design and circulated to establish the presence of any *de minimis* abstractions.
Other/multiple		
Environment Agency	Possible water resource requirements for compound facilities or construction processes should be considered.	The impact of construction activities on water resources has been considered and reported in Sections 14.9 and 14.11 of this chapter.

14.3.2 The full Scoping Opinion, as well as the Applicant's response regarding how and where comments have been addressed in the Environmental Statement and draft DCO, is included within Appendix 5.1 [TR010060/APP/6.3].

14.3.3 Table 14.2 identifies the key feedback received from the statutory consultation. All comments raised during the statutory consultation, as well as the Applicant's responses, are included in the Consultation Report [TR010060/APP/5.1].

14.3.4 Consultation has been ongoing with key stakeholders throughout development of the Environmental Statement as summarised in Tables 14.2 and 14.3.

Table 14.2 Key statutory consultation feedback for road drainage and the water environment

Stakeholder	Topic	Comment	Response
Chelmsford City Council July 2021	Drainage	A culvert runs underneath Main Road to the north of Boreham House, which feeds the lake via a spring; this should be investigated prior to any works within this area to ensure this is considered in the detailed design and execution of the works. Further, and to mitigate the impact of the construction works on the setting of Boreham House and its Registered Park and Garden, it is essential that the land take around the southern/south-eastern edge of the interchange is adequate to allow a planting scheme to mitigate the impacts. The land indicated on the current design is inadequate to provide the necessary mitigation. CCC would welcome the opportunity to discuss this matter further with National Highways prior to submission of its application to the Planning Inspectorate.	National Highways welcomes the suggestion and will consider this point during the design works (post-DCO application).
Essex County Council - Highways & Transportation Service	Drainage	Two drainage ponds and woodland planting are in the way of B1019 Link Road Option 1. These need to be relocated, if passive provision for the Option 1 route is to be provided.	Environmental mitigation has been reviewed and the design has been updated. The revised plans were published as part of the Supplementary Consultation that ran from 9 November to 19 December 2021.

Stakeholder	Topic	Comment	Response
Chelmer & Blackwater Navigation Limited 12 Aug 2021	Drainage	5. Can you please confirm the future use of the attenuation ponds and adjoining area and how these will be maintained in the future?	Please note the attenuation ponds are required to attenuate/store the increased flows/runoff to mitigate potential flood risk from the implementation of the proposed scheme. The attenuation ponds would include a regular inspection by the relevant maintenance authorities to ensure there are no sediments accumulation at inlets/outlets to the ponds, at flow control devices and outfall locations. Where necessary (confirmed through regular inspections) the maintenance would include clearing/removal of sediments from attenuation ponds and at flow control devices/outfalls to safeguard their desired functioning in future. Regular inspection would also be required if there are any overgrown vegetation/weeds including their clearing as and when required.
Environment Agency 16 Aug 2021	Watercourse crossings	The proposed river crossings appear to be designed as canalised drains, and risk repeating and compounding the mistakes that were made in the mid- twentieth century. The crossings need to be rethought as part of a functioning river system and designed to deliver the fully functioning ecosystems that we need for an uncertain future. If the crossings concept is led by fluvial geomorphology and ecology they will also provide drainage solutions. Any engineering solutions that are needed should be assessed holistically and collaboratively. There is the potential for biodiversity to be significantly adversely affected with the proposals as they are presently set out, and we could not currently agree that the new crossings would result in neutral impacts on fish and otter.	Crossing design has been considered following this comment and prior to the meeting with the Environment Agency on 16 September 2021 where potential changes to design and additional mitigation measures were discussed. Portal structures have been considered prior to and after the meeting, but also during optioneering. Optioneering found that portal structures would have substantial implications on the sustainable construction objectives of the proposed scheme, whilst also leading to wider adverse environmental effects during construction, relative to the chosen box culvert. Additional issues included cost and programme implications. Mammal ledges would be created within newly constructed or modified existing culverts where practicable, or other suitable mammal passage to be agreed. Mammal ledges would allow for movement of otters under the proposed scheme (as well as other species such as badgers). Embedded mitigation measures are summarised in Section 14.10 of this chapter.

Stakeholder	Topic	Comment	Response
Environment Agency 16 Aug 2021	Disconnection of Ordinary Watercourse 15a	The PEIR states that following channel realignment of Rivenhall Brook, Ordinary Watercourse 15a would be disconnected from its source, and that this would likely cause flow to cease leading to an ephemeral flow regime dependent on antecedent rainfall events. This would have negative impacts on the ecology and hydromorphology of the watercourse, and therefore alternative options should be considered.	Ordinary Watercourse 15a is a dry, heavily vegetated drain, which would receive flows from a new source - the proposed attenuation pond. Also, further observations indicate this channel is a surface water pathway. Rainfall would still be collected here, however as the source has changed it no longer depends on flood flows from Rivenhall Brook. (As advised to the Environment Agency during a meeting on the 15 September 2021.)
Environment Agency 16 Aug 2021	Culverting of Ordinary Watercourse 11	Ordinary Watercourse 11 is proposed to be extensively culverted. It should be explained why such extensive culverting is required, as watercourses should be culverted for the shortest possible lengths for both flood risk and biodiversity reasons.	The culvert at Ordinary Watercourse 11 is split into three separate culverts extending below the offline junction to reduce its length. Portal culverts and bridges have been considered for the new structures. However, these have been ruled out due to incompatibility with the proposed scheme requirements of environmentally sustainable construction. Another option considered was the use of 30 additional potential portal culverts but these would have deviated from the objective of the proposed scheme to be environmentally sustainable. There has been discussion on shortening this culvert by altering the angle. This option has discussed further in section 14.10 as a potential modification to the design. There is limited room within the Order Limits to carry out any changes to the current culvert design. There is a potential alternative route for the culvert that has been investigated further as part of the Environmental Statement, crossing the A12 diagonally. This would reduce the length of the culverting, however other implications regarding space associated with the neighbouring Colemans Farm Quarry could occur.

Stakeholder	Topic	Comment	Response
Environment Agency 16 Aug 2021	WFD	We are also currently generally satisfied in respect of how the PEIR (Highways England, 2021b) has specifically addressed WFD issues. We would however highlight that although the overall aim of projects should be 'no deterioration of overall status in watercourses', as reported in 14.3.2, the WFD additionally requires that there is no deterioration in the individual elements. This needs to be acknowledged and it should be ensured that the individual elements are also assessed and considered during the detailed design process. We note that the Preliminary WFD Assessment mentions WFD requirements to prevent the deterioration of waterbody class. It should be acknowledged that these 'no deterioration' requirements also apply independently to each of the elements that come together to form the waterbody classification. (See the 'Weser Ruling' by the European Court of Justice in 2015).	The deterioration in status of individual quality elements of the WFD Regulations has been considered and assessed according to the 'Weser Ruling'. This has been in line with the Environment Agency's comments throughout the site-specific impact assessment found in the detailed WFD Regulations assessment.

Stakeholder	Topic	Comment	Response
Environment Agency 16 Aug 2021	Watercourse crossings	Therefore we agree with the PEIR, outlining the additional mitigation for hydromorphology, that the culvert should be shortened to the width of the highway structure. It may be preferable to install a bridge, or a portal culvert, in order to ensure that the natural bed and banks are maintained at the very least. This option should also be considered. We note that new culverts are proposed on Rivenhall Brook and Domsey Brook, with 'around 30 new culvert structures for Ordinary Watercourses and drainage channels'. In general, culverts should only be considered if the use of a bridge has been ruled out, and in each instance where a culvert is proposed justification as to why a bridge cannot be used should be provided. If it is possible to install a bridge instead then this should be used in preference on every occasion where it is feasible, for flood risk, blockage risk, hydromorphology and biodiversity reasons (as highlighted above). If a culvert is considered to be the only option, then portal culverts may be a more preferable option compared to standard culverts as such structures can enable the natural bed and banks of the watercourse to be retained. The length of any culvert or bridge structure should be as short as possible.	Portal culverts and bridges have been considered for the new structures. However these have been ruled out due to incompatibility with the scheme requirements of environmentally sustainable construction. Best practice / standard mitigation has been incorporated into the design, for example at Rivenhall Brook and Domsey East culverts, including provision of gravel beds within the culverts.

Stakeholder	Topic	Comment	Response
Environment Agency 16 Aug 2021	Hydromorphology	We wish to see all outfalls to watercourses set back in a short bay rather than directly into the riverbank and channel. This reduces overall engineering impact on the watercourses and adds a small amount of diverse habitat to the channels, rather than removing natural bank.	Agreed – this has been stated as part of standard mitigation and recorded in the Register of Environmental Actions and Commitments (REAC) within the first iteration of the Environmental Management Plan (EMP) [TR010060/APP/6.5], which follows CIRIA good practice standards.
Environment Agency 16 Aug 2021	Geomorphology	River Brain Crossing The current existing crossing has a high cill which forms an unnatural riverbed and holds up the water level upstream in Witham. The proposals should be revisited to see what improvements can be made here. The current result is a silty, slow flowing ponded section which then runs over a concrete bed which is very shallow and inhospitable for wildlife in summer. We request that this be a subject for mitigation and if possible a more natural meandering low flow channel be cut through the bed here.	The cill forms part of the foundation of the River Brain crossing abutments and removal would lead to significant implications on the structural integrity of the crossing. To remodel the foundations would involve construction of a temporary offline road to the south through sensitive habitats, some of which are protected under legislation. Furthermore, this would be an enhancement to improve upon an existing problem, rather than mitigation for the effects of the proposed scheme. Enhancements to the River Brain were not practicable for biodiversity net gain, given legacy constraints over the 30-year monitoring period associated with maintaining biodiversity net gain, as National Highways would not be permanently acquiring the land localised to Brain Bridge. Furthermore, improvements to in-channel features may increase flood risk to properties nearby to Brain Bridge.

Stakeholder	Topic	Comment	Response
Environment Agency 16 Aug 2021	Geomorphology	New Channels Any new designed channels should be meandering in plan form, natural in shape and materials and should incorporate two stage channels to provide narrower low flow channels with gravel bottoms. They should be designed to be self-cleaning and of exemplary natural form incorporating plentiful habitat to attempt to compensate for the dark culverts and crossings.	Noted. Gently sinuous channels have been considered as part of mitigation. This includes augmenting gravels into the realignments and replicating geomorphological sequences along the Main River realignments. Two-stage channels have been incorporated for most main channels (excluding the Roman River due to limited space) and will be carried forward during detailed design. Issues have arisen at the Roman River due to available space and the presence of priority woodland habitat. This may involve a one-stage channel with gently sloping banks and varied channel bottom widths. Sinuous one stage channels have been proposed for the drainage channels (Ordinary Watercourses).
Environment Agency 16 Aug 2021	Geomorphology	These river works appear to be unnecessarily damaging and should be ameliorated before moving on to the next stage. Once that is done we would encourage a reconsideration of relevant and effective mitigation.	Amelioration would take place through site-specific measures incorporated into the design. Mitigation has been discussed to further reduce damage to the rivers. Queries raised are addressed in relation to each watercourse.
Environment Agency 16 Aug 2021	Groundwater	We note that local abstractions will be investigated along with Groundwater Dependent Terrestrial Ecosystems; with mitigation for all activities that could impact on groundwater resources to be addressed through measures within the EMP. It should be ensured that we are able to review and comment on the detailed proposals.	The assessment of groundwater abstractions and GWDTEs is presented in Appendix 14.4 [TR010060/APP/6.3]. Detailed proposals would be developed prior to construction and would be subject to a consenting process.

Stakeholder	Topic	Comment	Response
Environment Agency 16 Aug 2021	Water Quality	Inworth Road Water quality impacts should also be considered. Drainage attenuation ponds are referred to as part of the proposed approach which should improve the quality of run off. The SuDS design guide for Essex should be referred to and utilised: Water Quality Essex Design Guide	HEWRAT assessments have been undertaken in accordance with DMRB LA 113 (Highways England, 2020a) to consider the water quality impacts of the Inworth Road improvements. HEWRAT (previously HAWRAT) has been developed through research undertaken by National Highways (previously Highways Agency) with the Environment Agency. Essex County Council's Sustainable Drainage Systems Design Guide (2020) refers to the CIRIA SuDS Manual (C753, 2015a). Table 26.1 of the Manual advocates assessment of water quality using increasing levels of complexity. The complexity of the design methods in Table 26.1 progresses to detailed risk assessment and ultimately to process-based modelling. HEWRAT incorporates both these methods in that it uses site-specific information and also statistical distributions of likely concentrations and loadings in the runoff. HEWRAT therefore provides a detailed and site-specific approach to water quality risk management.

Stakeholder	Topic	Comment	Response
Environment Agency 16 Aug 2021	Water Quality	Water Quality PEIR Appendix We have no objections to the water quality assessments being used in this report, and we agree that the installation of SuDS features has the potential to provide a significant improvement over the existing situation. We note that after the currently proposed mitigation measures are applied, environmentally significant effects are reported for 4 outfall assessments. It is important that as the design of the proposed scheme progresses, priority is given to changes that will reduce the impacts, so they are no longer assessed as environmentally significant. We welcome the commitment to continue to look at how the environmental impacts of pollution risks may be further reduced.	Noted. Work during the Environmental Statement stage has continued to refine the drainage design and inform the Environmental Assessment. Amendments have been included in the assessment which reduce the effects of the four outfalls previously reported as having significant effects, which are no longer considered to be significant.

Table 14.3 Record of pre-Environmental Statement consultation undertaken with key stakeholders

Date	Stakeholder	Topic
09/06/20	Environment Agency	Meeting to present River Ter, Boreham Brook, and Rivenhall Brook baseline flood modelling to the Environment Agency.
18/06/20	Environment Agency	Meeting to present Domsey Brook and Roman River baseline flood modelling to the Environment Agency.
10/07/20	Environment Agency	Meeting to present the WFD Regulations and hydrogeology aspects of the proposed scheme to the Environment Agency.
23/09/20	Environment Agency	Meeting to present River Brain and River Blackwater baseline flood modelling to the Environment Agency.
04/11/20	Essex County Council	Meeting to present the water quality and drainage aspects of the proposed scheme to Essex County Council.
19/11/20	Environment Agency	Meeting to discuss water quality and drainage aspects of the proposed scheme with the Environment Agency.
19/01/21	Environment Agency	Meeting to present the with-scheme hydraulic modelling outputs and proposed flood mitigation to the Environment Agency.
19/01/21	Environment Agency	Meeting to present the WFD Regulations (geomorphology and water quality) aspects of the proposed scheme to the Environment Agency.
24/02/21	Essex County Council Highways	Meeting to present the drainage design criteria for the local roads to Essex Highways.
13/05/21	Environment Agency	Meeting to present the findings of the Preliminary Flood Risk Assessment to the Environment Agency.
21/05/21	Essex County Council	Meeting to present the findings of the Preliminary Flood Risk Assessment to Essex County Council.
07/07/21	Anglian Water	Email exchanges to determine licence and operational status of Messing-cum-Inworth public water supply abstraction wells. No response at the time of writing.
08/07/21	Essex County Council	Meeting to present the drainage design update of the proposed scheme to Essex County Council.

Date	Stakeholder	Topic
15/09/21	Environment Agency	Meeting to review the Environment Agency's comments on the PEIR (Highways England, 2021b) in relation to WFD Regulations, watercourse crossings and culverts.
09/11/21	Essex County Council	Meeting to present drainage design information that would be included in the Drainage Strategy.
22/11/21	Environment Agency	Follow up to meeting of 15/09/21 to discuss the same topics, plus construction aspects of watercourse crossings and permitting of works.
17/12/21	Essex County Council	Meeting to present drainage design information that would be included in the Surface Water Drainage Strategy (Appendix 14.6 [TR010060/APP/6.3]).
03/02/22	Essex County Council	Meeting to present the HEWRAT results for the PEIR stage.
03/03/22	Environment Agency	Presentation of groundwater Environmental Statement emerging findings.
12/03/22	Environment Agency	Follow up presentation of groundwater Environmental Statement findings and proposed studies for detailed design phase.
13/05/22	Environment Agency	Email to confirm Messing-cum-Inworth Public Water Supply was dropped from Anglian Water's licence in 2016 and that the Environment Agency assumed the wells have been decommissioned and the Environment Agency will be removing the associated source protection zones for these wells.
22/06/22	Environment Agency	Initial discussion on environmental permitting and consenting process.
1/07/22	Essex County Council	Initial discussion on ordinary watercourse consenting process.

14.4 Legislative and policy framework

Legislation

14.4.1 Legislation relevant to the water environment is summarised in Table 14.4.

Table 14.4 Key water legislation

Legislation	Description and relevance
Acts of Parliament	
Reservoirs Act 1975	This legislation was enacted to protect against escapes of water from large reservoirs or from artificially created or enlarged lakes. The Reservoirs Act 1975 has been amended by the Flood and Water Management Act 2010. It essentially provides regulation for assessing risk of escape of water and ensuring that reservoirs are regularly monitored, and their asset status (integrity) is regularly assessed. This is enforced by the Environment Agency in England.
Environmental Protection Act 1990 (as amended)	The act sets out the fundamental structure and authority for waste management and control of emissions into the environment across England (plus Wales and Scotland)
Land Drainage Act 1991 (as amended)	The act requires that a watercourse be maintained by its owner in such a condition that the free flow of water is not impeded. Sets out the requirement that a watercourse be maintained by its owner in such a condition that the free flow of water is not impeded. The riparian owner must accept the natural flow from upstream but need not carry out work to cater for increased flows resulting from some types of works carried out upstream.
Water Resources Act 1991 (as amended)	The act regulates water resources, water quality, water pollution, flood defense, and provides for the general management of water resources, the standards expected for controlled waters, and prevention/mitigation through flood defense.
Water Industry Act 1991 (as amended)	The act regulates water and sewerage industries and lays out the legislative provisions in relation to discharge consents to sewers.
Environment Act 1995 (as amended)	This legislation set the standard for environmental management and made provision for the establishment of the Environment Agency. The Environment Agency is a key consultee for water environment elements of the Project.
Water Act 2003 (as amended)	This act amends the Water Resources Act 1991 to improve long-term water resource management. The four broad aims of the act are as follows: • The sustainable use of water resources • Strengthening the voice of consumers • A measured increase in competition • The promotion of water conservation

Legislation	Description and relevance
Climate Change Act 2008	This legislation requires that emissions of carbon dioxide and other greenhouse gases are reduced and that climate change risks are prepared for. The Project is expected to consider the impact of climate change when assessing future effects.
Flood and Water Management Act 2010	The act established LLFAs with responsibilities to manage local sources of flooding.
Water Act 2014	This legislation governs public water supply, water companies and provides greater protection to consumers. It sets out the main powers for water companies and provides a framework for licensing and permitting.
Regulations	
Urban Wastewater Treatment (England and Wales) Regulations 1994	The regulations transposed the Urban Waste Water Directive 1991 (91/271/EEC). The regulations protect the environment from the adverse effects of urban wastewater discharges and discharges from certain industrial sectors, in particular the collection, treatment and discharge of domestic wastewater; or the mixture of domestic wastewater and industrial wastewater and/or runoff rain water.
The Control of Pollution (Applications, Appeals and Registers) Regulations 1996	The regulations prescribe the procedure to be followed in relation to applications for consents (including discharge consents) under Chapter II of Part III of the Water Resources Act 1991.
Control of Pollution (Oil Storage) (England) Regulations 2001	The regulations control the above-ground storage of oil and oil-derived products so as to prevent pollution of the water environment.
Flood Risk Regulations 2009 (as amended)	The regulations transposed the Floods Directive 2007/60/EC and established a framework for assessing and managing flood risk, aimed at reducing the negative impact of flooding on human health, the environment, cultural heritage and economic activity. The regulations require the preparation of flood risk assessments, flood hazard maps, flood risk maps and flood management plans for river basin districts in England and Wales and certain cross-border river basin districts.
Nitrate Pollution Prevention Regulations 2015 (as amended)	The regulations transposed the requirements of the Nitrates Directive 91/676/EEC. The regulations require action to be taken to reduce ground and surface water pollution caused by nitrates released from agricultural sources, and provides for the designation of land as nitrate vulnerable zones.
The Private Water Supplies (England) Regulations 2016 (as amended)	The regulations set out standards for private water supplies intended for human consumption including wells and boreholes. The regulations impose a duty on the local authority to carry out a risk assessment of private water supplies and to monitor the supply to ensure water quality standards.

Legislation	Description and relevance
The Environmental Permitting (England and Wales) Regulations 2016 (as amended)	The regulations incorporate the requirements of more than 20 EU directives, including the Drinking Water Directive (98/83/EC), the Groundwater Directive (2006/118/EC), the Water Framework Directive (2000/60/EC) and the Priority Substances Directive (2008/105/EC) (the latter is also known as the Environmental Quality Standards Directive). The regulations set out the regulatory framework for the control of water discharge activities through environmental permitting, exclude some discharges from control as water discharge activities, exempt some water discharge activities from environmental permitting, and provide for compliance obligations. They apply environmental quality standards to waters and certain pollutants and set out measures to prevent discharges of hazardous substances and limit discharges of non-hazardous pollutants into surface and groundwater.
The Water Supply (Water Quality) Regulations 2016	The regulations consolidated legislation concerning the quality of water supplies for human consumption in England. They aim to prevent contamination of water supply and ensure standards for water quality are met.
The Conservation of Habitats and Species Regulations 2017	The Conservation of Habitats and Species Regulations 2017 ('the Habitats Regulations 2017') implement Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora ('the Habitats Directive') and elements of Directive 2009/147/EC on the conservation of wild birds ('the Birds Directive') in England, Wales and, to a limited extent, Scotland and Northern Ireland. The objective is to protect biodiversity through the conservation of natural habitats and species of wild fauna and flora through rules for the protection, management and exploitation of such habitats and species.
The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017	The regulations transposed the Water Framework Directive 2006/60/EC and require that River Basin Management Plans (RBMP) are prepared for each river basin district in England and Wales that include environmental objectives to achieve and maintain good ecological and chemical status for all surface and groundwater bodies. Public bodies must take into account river basin management plans and any supplementary plan when exercising their functions that could affect the quality of the water environment.

National policy

National Policy Statements

14.4.2 The National Networks National Policy Statement (NNNPS), (Department for Transport, 2014) sets out the Government's policies to deliver the development of Nationally Significant Infrastructure Projects on the national road and rail networks in England. The Secretary of State uses the NNNPS as the primary basis for making decisions on DCO applications.

14.4.3 Key policy from the NNNPS relevant to this aspect is set out in Table 14.5.

Table 14.5 NNNPS requirements for road drainage and the water environment

NNNPS paragraph	NNNPS requirement	How this is addressed in the assessment
5.91 – 5.97	Sets out the requirements for an FRA to accompany the application for a project in areas at risk of flooding. Paragraph 5.91 explains that inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk, although essential transport infrastructure is permissible in areas of high flood risk subject to the requirements of the Sequential and Exception Tests.	The proposed scheme is over one hectare in size and traverses all Flood Zones. Consequently, an FRA has been completed and can be found in Appendix 14.5 [TR010060/APP/6.3]. Appendix 14.5 FRA assesses the impact to and from the proposed scheme on all sources of flood risk and commits to mitigation. Mitigation is also presented in the REAC, within first iteration EMP [TR010060/APP/6.5]. The mitigation would ensure the proposed scheme does not increase flood risk and is safe for its lifetime including the predicted impact of climate change. The Environment Agency published an update to their guidance on the incorporation of the predicted impact of climate change to rainfall intensity in May 2022. Given the timing of the revised guidance being published, it will not be possible to incorporate it into the relevant DCO application documents and also ensure the application is submitted in a timely fashion (given the time it would take to update the relevant documents). However, it is proposed that the guidance will be considered post-submission (and ideally pre-examination), by way of a sensitivity test that will report the implications of the new guidance on the assessments undertaken to date. The results of this will be submitted to the examination and will, as necessary to reflect any updates, be the basis on which the detailed design of the scheme is undertaken, should the DCO be granted. Discussions with flood risk management bodies (the Environment Agency and Essex County Council) have been undertaken to inform the design process. Hydraulic models and results have been submitted for review and acceptance by the Environment Agency in advance of the DCO submission.
5.93	Assessment of impact should take climate change into account.	
5.99	When determining an application, the Secretary of State should be satisfied that flood risk would not be increased elsewhere, that the most vulnerable development is located in the areas of lowest risk, and that it is appropriately flood resilient and resistant.	
5.109	The proposed scheme should be designed and constructed to remain operational and safe for users in times of flood.	

NNNPS paragraph	NNNPS requirement	How this is addressed in the assessment
5.100	The Secretary of State will need to be satisfied that the proposed drainage system complies with any National Standards published by Ministers under Paragraph 5(1) of Schedule 3 to the Flood and Water Management Act 2010. In addition, the development consent order, or any associated planning obligations, will need to make provision for the adoption and maintenance of any Sustainable Drainage Systems (SuDS), including any necessary access rights to property. The Secretary of State should be satisfied that the most appropriate body is being given the responsibility for maintaining any SuDS, taking into account the nature and security of the infrastructure on the proposed site.	Appendix 14.6: Surface Water Drainage Strategy [TR010060/APP/6.3] identifies that the proposed scheme's drainage has been designed in accordance with all national standards that are relevant to it. The proposed scheme has been designed in accordance with DMRB including CG501 – Design of highway drainage systems. DMRB provides a standard for the design of highways projects that are typically undertaken by National Highways. The DMRB is development-specific rather than generic for all developments and thus does not align fully with all aspects of the non-statutory technical standards in two areas, discharge rates and volume control. The proposed scheme discharge rates have been restricted to a minimum 5 l/s, which is appropriate and takes into account blockage risk and maintenance; but is higher in places than the minimum rate mandated by standard S2 of the non-statutory technical standards for sustainable drainage systems (Defra, 2015). There would be no adverse effects as a result of the use of the 5l/s minimum discharge rate for the proposed scheme. This is because in the majority of locations this increase in proposed discharge rates would be anticipated, discharges in adjacent proposed catchments with the same receptors have been adjusted (reduced) to ensure that there is no overall increase to the existing site allowable discharge rates. Where this adjustment has not been possible an assessment has been undertaken of the impact of the 5l/s discharge rate on flood risk. This is presented in the Flood Risk Assessment (ES Appendix 14.5 of the ES ([TR010060/APP/6.3]) and identifies a negligible impact on the surface water drainage flood risk, generally as a result of the existing flows within the receiving watercourses being significantly larger than the change in flows that would result from the proposed scheme. The non-statutory technical standards also include standards S4-S6, which relate to volume control from drainage discharges.

NNNPS paragraph	NNNPS requirement	How this is addressed in the assessment
		The design standards in DMRB do not include volume control within either CG501 – Design of highway drainage systems or LA113 – Road drainage and the water environment (this provides a methodology for the assessment of impacts from highways projects). However, the proposed scheme incorporates SuDS. Attenuation within SuDS features have been provided to ensure no flooding for a 1% (1 in 100) Annual Exceedance Probability event plus a 20% climate change allowance and tested for a 40% climate change allowance. National Highways would be responsible for the maintenance and inspection of all drainage infrastructure, except where such infrastructure will be adopted by, and become the responsibility of the relevant local authorities.
5.112-5.115	Site layout and surface water drainage systems should cope with events that exceed the design capacity of the system, so that excess water can be safely stored on or conveyed from the site without adverse impacts. The sequential approach should be applied to the layout and design of the project. Vulnerable uses should be located on parts of the site at lower probability and residual risk of flooding. Applicants should seek opportunities to use open space for multiple purposes such as amenity, wildlife habitat and flood storage uses. Opportunities can be taken to lower flood risk by improving flow routes, flood storage capacity and using SuDS.	This chapter and Appendix 14.6 Surface Water Drainage Strategy Report [TR010060/APP/6.3] show that drainage has been designed to reduce the risk of flooding elsewhere including incorporation of climate change allowances. Appendix 14.6 Surface Water Drainage Strategy Report identifies that the drainage has been designed according to national SuDS best practice. This includes the principles of Defra (2015) Sustainable Drainage Systems, non-statutory technical standards for SuDS and the Design Manual for Roads and Bridges CG 501 Design of Highway Drainage Systems (Highways England, 2020e). Objectives of the proposed scheme are to improve traffic flow, journey safety and reliability between Chelmsford and the A120. As there are no reasonable alternatives, the proposed scheme is deemed to have passed the Sequential and Exception Tests in this instance.
5.220	The proposed scheme should prevent both new and existing development from contributing to, or being put at unacceptable risk from, or being adversely affected by, water pollution.	The detailed assessment of the impact of the proposed scheme on water quality are included in the WQAR (Appendix 14.1 [TR010060/APP/6.3]) and the overall results of the assessment of likely significant

NNNPS paragraph	NNNPS requirement	How this is addressed in the assessment
5.221 – 5.223	The applicant should carry out an assessment of the impacts of the proposed scheme on water quality, water resources and the physical characteristics of the water environment, as part of an Environmental Statement. Projects that are improvements to the existing infrastructure, such as road widening, should where feasible make use of opportunities to improve upon the quality of existing discharges where these are identified and shown to contribute towards WFD commitments.	effects are included in Section 14.11 of this chapter. Discussions have taken place with the Environment Agency and with Anglian Water as the water supplier and sewerage undertaker. The impacts of the proposed project on water quality, water resources and physical characteristics are addressed within this chapter.
5.226	In terms of WFD Regulations compliance, the overall aim of projects should be no deterioration of ecological status in watercourses.	Details of compliance and support of no deterioration are included in the WFD Regulations Compliance Assessment (Appendix 14.2 [TR010060/APP/6.3]).
5.227	The Examining Authority and the Secretary of State should consider proposals put forward by the applicant to mitigate adverse effects on the water environment and whether appropriate requirements should be attached to any development consent and/or planning obligations.	Measures to mitigate adverse effects on the water environment are presented in Section 14.10 of this chapter. These measures are secured in the REAC, within the first iteration of the EMP [TR010060/APP6.5].
5.230	Projects are required to adhere to National Standards for SuDS, which promote the most sustainable approach but recognise feasibility, and use of conventional drainage systems as part of a sustainable solution for any given site given its constraints.	Details of the SuDS measures included in the proposed scheme are included in Surface Water Drainage Strategy (Appendix 14.6 [TR010060/APP/6.3]).

14.4.4 As set out in Chapter 1: Introduction, of the Environmental Statement [TR010060/APP/6.1], the assessment has considered the Overarching National Policy Statement for Energy (EN-1) and National Policy Statement for Gas Supply Infrastructure and Gas and Oil Pipelines (EN-4) (Department of Energy and Climate Change, 2011a; 2011b) in relation to the diversion of an existing high pressure gas main (the ‘gas main diversion’) owned and operated by Cadent Gas Limited (Cadent). Draft versions of the updated EN-1 and EN-4 have also been considered (Department for Business, Energy and Industrial Strategy, 2021a; 2021b).

14.4.5 A review of the relevant requirements of EN-1 and EN-4 (including the draft updated versions), relating to the EIA of the gas main diversion works, identified that the requirements are not materially different to those set out in the NNNPS. As such, it is considered that by meeting the NNNPS requirements set out in Table 14.5, the requirements of EN-1 and EN-4 are also met.

National Planning Policy Framework

14.4.6 The National Planning Policy Framework (NPPF) (Ministry of Housing, Communities and Local Government (MHCLG), 2021) contains a number of statements which are relevant to water resources and flood risk. These include the following:

- Making use of undeveloped land in mitigating flood risk
- Taking a proactive approach to mitigating and adapting to climate change taking into account the long-term implications for flood risk, coastal change and water supply
- Taking full account of flood risk in the planning system including planning for climate change

14.4.7 Development should not cause unacceptable levels of water pollution and should help improve water quality wherever possible.

14.4.8 Paragraphs 174 and 175 of the NPPF (MHCLG, 2021) also contains statements relevant to water quality which include contributing to and enhancing the natural and local environment by preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of water pollution. Development should, wherever possible, help to improve local environmental water quality.

14.4.9 The requirements of the NPPF (MHCLG, 2021) have been taken into account in the assessment, with particular regard given to potential impacts in relation to flood risk and water quality.

Planning Practice Guidance

14.4.10 Planning Practice Guidance for Flood Risk and Coastal Change (Department for Levelling Up, Housing and Communities; and MHCLG, revised 2021) provides guidance on assessing the significance of flood risk and coastal change and sets out the steps to be taken for assessment of a proposed development in terms of flood risk.

14.4.11 Planning Practice Guidance for Water Supply, Wastewater and Water Quality (Department for Levelling Up, Housing and Communities; and MHCLG, revised 2019) sets out how concerns related to water can be addressed and mainly focuses on residential and commercial developments.

14.4.12 This guidance has been considered in the assessment as part of the assessments of water quality and flood risk.

Future water: The Government's water strategy for England

14.4.13 Future water: The Government's water strategy for England (Defra, 2011a) sets out the Government's long-term vision for water and the framework for water management in England, and includes advice and guidance for the sustainable management of the water environment and water quality to ensure no compromise in environmental quality of future generations.

A Green Future: Our 25 Year Plan to Improve the Environment

14.4.14 A Green Future: Our 25 Year Plan to Improve the Environment (Defra, 2011b) includes specific goals to: reduce the environmental impact of water abstraction; meet the objectives of RBMPs under the WFD Regulations (Water and Environment (England and Wales Regulations (2017); reduce leakage from water mains; improve the quality of bathing waters; restore protected freshwater sites to a favourable condition; and do more to protect communities and businesses from the impact of flooding, coastal erosion and drought.

Anglian river basin district river basin management plan

14.4.15 The Anglian river basin district RBMP (Environment Agency, 2016) sets out how organisations, stakeholders and communities should work together to improve the water environment.

14.4.16 Further details relating to this RBMP (Environment Agency, 2016) and its relevance to the proposed scheme are presented in Appendix 14.2 [TR010060/APP/6.3].

Local policy

14.4.17 In addition to the national policy set out in the NNNPS, the proposed scheme has also had regard to relevant local plans and policy. A summary of the policy framework is provided in Appendix 1.1 [TR010060/APP/6.3] and local policy relevant to RDWE is presented in Table 14.6.

Table 14.6 Local policy requirements for RDWE

Local authority	Local policy document and requirements	How this is addressed in the assessment
Braintree District Council	Local Development Framework Core Strategy (Adopted 2011, Amended 2021) Policy CS8 Natural Environment and Biodiversity All development proposals will take account of the potential impacts of climate change and ensure the protection and enhancement of the natural environment, habitats and biodiversity and geo-diversity of the District.	Policy CS8: Compliance is demonstrated in the FRA (Appendix 14.5 [TR010060/APP/6.3]). Policy CS8: the drainage design includes measures for the treatment of surface water runoff. In some instances these measures result in a betterment upon existing conditions. Assessment results indicate that the greatest significance of the effects is slight adverse, and as such, the effects are not environmentally significant in line with DMRB standard. Policy CS8: The hydromorphology of watercourses scoped into this assessment have been evaluated via the hydromorphology baseline assessment, the significance of effect assessment whereby mitigation has been incorporated to prevent any significant adverse effects. The Water Environment Regulations (WFD Regulations) Compliance Assessment ([TR010060/APP/6.3]) also evaluates the impact to the natural environment, whilst biodiversity net gain has also been evaluated via the rivers and streams metric.

Local authority	Local policy document and requirements	How this is addressed in the assessment
Braintree District Council	Local Plan Review (2005), saved policies Policy RLP 62 Development Likely to Give Rise to Pollution, or the Risk of Pollution Development needs to ensure no unacceptable risk of uncontrolled discharges or emissions occurring, which could cause harm to land use, including the effects on health and the natural environment. Policy RLP 71 Water Supply, Sewerage and Land Drainage Planning permission will not be given where there is inadequate water supply, sewerage or land drainage systems (including water sources, water and sewage treatment works) available to meet the anticipated demands of the development, unless there is an agreed phasing arrangement between the developer and the relevant service provider, for the provision of the necessary infrastructure. Policy RLP 72 Water Quality Development will not be permitted which poses an unacceptable risk to the quality of the underlying groundwater, or surface waters.	Policy RLP62: HEWRAT assessments have been undertaken on the proposed drainage design with treatment of surface water runoff included. Assessment results indicate that the greatest significance of the effects is slight adverse, and as such, the effects are not environmentally significant. Policy RLP71: The management of construction water supply and wastewater is addressed in the first iteration EMP [TR010060/APP/6.5]. Policy RLP 72: The impact on surface and groundwater quality is addressed in Section 14.11 of this chapter.
Braintree District Council	Braintree Publication Draft Local Plan Section 2 (June 2017) (Emerging) Policy LPP 55 Layout and Design of Development Development proposals will incorporate measures for environmental sustainability throughout the construction, occupation and demolition of the development including climate change, flood resilience and resistant construction. Policy LPP 73 Protecting and Enhancing Natural Resources, Minimising Pollution and Safeguarding from Hazards Proposals for all new developments should prevent unacceptable risks from all emissions and other forms of pollution (including light and noise pollution) and ensure no deterioration to either air or water quality.	Policy LPP 55: The development is flood resistant and resilient as set out in the FRA (Appendix 14.5 [TR010060/APP/6.3]). Policy LPP 73: HEWRAT assessments have been undertaken on the proposed drainage design with treatment of surface water runoff included. Assessment results indicate that the greatest significance of the effects is slight adverse, and as such, the effects are not environmentally significant.

Local authority	Local policy document and requirements	How this is addressed in the assessment
	Policy LPP 78 Flooding Risk and Surface Water Drainage Proposals will be located to avoid the risk of flooding in a sequential manner. Development must be designed to be flood resilient and resistant and safe for its users for the lifetime of the development, taking climate change and the vulnerability of the residents into account. Development will take climate change into account in accordance with the most up to date analysis of flood risk and will not increase flood risk elsewhere. • Retain at least an 8m wide undeveloped buffer strip alongside Main Rivers and explore opportunities for riverside restoration. Any proposed development within 8m of a Main River watercourse will require an environmental permit from the Environment Agency. • Retain at least a 3m buffer strip on at least one side of an Ordinary watercourse. Any development that could impact the flow within an Ordinary Watercourse will require consent from Essex County Council (as LLFA). • All new development within Flood zone 2 and 3 must not result in a net loss of flood storage capacity. Where possible opportunities should be sought to achieve an increase in the provision of floodplain storage. • Ensure there is no adverse impact on the operational functions of any existing flood defence infrastructure and new development should not be positioned in areas which would be in an area of hazard should defences fail. Where the development sites will benefit from the construction of Flood Management Infrastructure such as Flood Alleviation Schemes, appropriate financial contributions will be sought.	Policy LPP 78: Compliance is demonstrated in the FRA (Appendix 14.5 [TR010060/APP/6.3]). In places, replacement flood storage capacity would be provided by increased flooding of land to be acquired for the proposed scheme, rather than through construction of storage areas. Buffer strips along watercourses within the proposed scheme are discussed in Section 14.10.28 of this chapter. LPP 79: The Surface Water Management Plan has been reviewed as part of the Flood Risk Assessment. Policy LPP 80: Drainage design is discussed in the Surface Water Drainage Strategy (Appendix 14.6 [TR010060/APP/6.3]).

Local authority	Local policy document and requirements	How this is addressed in the assessment
	Policy LPP 79 Surface Water Management Plan The Council will require development to be in compliance with and contribute positively towards delivering the aims and objectives of the Braintree and Witham Surface Water Management Plan as may be updated or superseded. Policy LPP 80 Sustainable urban Drainage Systems All new development of sufficient size will incorporate appropriate Sustainable Drainage Systems (SuDS).	
Chelmsford City Council	Chelmsford Local Plan, May 2020 Strategic Policy S2 – Addressing Climate Change and Flood risk The Council, through its planning policies and proposals that shape future development, will seek to mitigate and adapt to climate change, minimising the impact on flooding. Strategic Policy S9 – Infrastructure Requirements Policy DM18 – Flooding/SuDS New development must be safe from all types of flooding and suitable strategic and site level measures will need to provide appropriate flood risk management. The development must not worsen flood risk elsewhere.	Policies S2 and S9: Compliance with policies relating to flood risk is demonstrated in the FRA (Appendix 14.5 [TR010060/APP/6.3]). Policy S9: Drainage design is discussed in the Surface Water Drainage Strategy (Appendix 14.6 [TR010060/APP/6.3]).
Colchester Borough Council	Colchester Core Strategy, July 2014 ENV1 – Environment New development in rural locations should adopt a sequential approach.	Policy ENV1: The FRA (Appendix 14.5 [TR010060/APP/6.3]) includes details of the Sequential Test undertaken on the proposed scheme. Policy ENV5: HEWRAT assessments have been undertaken on the proposed drainage design with treatment of surface water

Local authority	Local policy document and requirements	How this is addressed in the assessment
	Colchester Local Plan 2017 – 2033 Section Two – Local Plan for Colchester (Emerging) Policy ENV5: Pollution and Contaminated Land Proposals will be supported that will not result in an unacceptable risk to public health or safety, the environment, general amenity or existing uses due to the potential of air pollution, noise nuisance, surface / ground water sources or land pollution. Permission will only be granted where the Council is satisfied that after selection of appropriate mitigation the development, alone and cumulatively, will not have an unacceptable significant impact on air quality, health and well - being… Policy PP1: Generic Infrastructure and Mitigation Requirements Developments must include appropriate SuDS for managing surface water runoff within the overall design and layout of the site. Policy DM23: Flood Risk and Water Management Development will only be supported where it can be demonstrated that the proposal meets flood management requirements in the NPPF, the PPG and policy DM23. Policy DM24: Sustainable Urban Drainage Systems All new residential and commercial development, car parks and hard standings should incorporate Sustainable Drainage Systems (SuDS) appropriate to the nature of the site.	runoff included. Assessment results indicate that the greatest significance of the effects is slight adverse, and as such, the effects are not environmentally significant. Contaminated land is discussed in Chapter 10: Geology and soils of the Environmental Statement [TR010060/APP/6.1]. Policies PP1 and DM24: Drainage design is discussed in the Surface Water Drainage Strategy (Appendix 14.6 [TR010060/APP/6.3]). Policy DM23: Compliance with national planning policy is summarised in Table 14.5.

Local authority	Local policy document and requirements	How this is addressed in the assessment
Maldon District Council	Maldon District Approved Local Development Plan 2014 – 2029 (2017) Policy S1 Sustainable Development: 7) Enable and adapt to the effects of climate change by mitigating against flooding 8) Ensure new development is either located away from high flood risk areas or is safe and flood resilient Policy D2 Climate Change and Environmental Impact of New Development All development must minimise its impact on the environment by incorporating green infrastructure principles including flood mitigation. Policy D5 Flood Risk and Coastal Management To minimise the risk of flooding, all development must not increase flood risk, must comply with national planning policy, demonstrate that the Sequential Test and, where necessary, Exception Test has been satisfactorily undertaken, and demonstrate how it will maximise opportunities to reduce the causes and impacts of flooding, and make best use of appropriate green infrastructure as part of the flood mitigation measures. Development should also have regard to the aims and objectives of other relevant strategies including the Maldon and Heybridge Surface Water Management Plan, the Shoreline Management Plan, the Catchment Flood Management Plans, any strategies adopted by the Marine Management Organisation and any other approved national and local SuDS standards.	Policies S1, D2 and D5: Where applicable to the proposed scheme, compliance with policies relating to flood risk is demonstrated in the FRA (Appendix 14.5 [TR010060/APP/6.3]). Policy D2: The use of SuDS is incorporated into the Surface Water Drainage Strategy (Appendix 14.6 [TR010060/APP/6.3]). Policy D5: The Surface Water Management Plan has been reviewed as part of the Flood Risk Assessment.

14.5 Assessment methodology

Assessment scope

14.5.1 Certain matters of the RDWE aspect have been scoped out of the assessment, in line with the Scoping Opinion (Planning Inspectorate, 2021), including the following:

- Risk of reservoir flooding – The Planning Inspectorate agrees that flooding due to reservoir failure may be scoped out of the Environmental Statement on the basis that such reservoirs are subject to a monitoring and maintenance regime and the probability of a flooding event is low.
- Risk of coastal flooding – The Planning Inspectorate agrees that coastal flooding can be scoped out of the Environmental Statement as the proposed scheme is not located near the coast, and none of the watercourses within the study area are tidal.

14.5.2 All other matters are scoped into this assessment as shown in Table 14.7. This scope is in line with the Scoping Opinion.

Table 14.7 Summary of RDWE scope

Matters to assess	Scoped in – construction	Scoped in – operation
Surface water quality	✓	✓
Fluvial geomorphology	✓	✓
Groundwater	✓	✓
Flood risk	✓	✓
WFD Regulations compliance	✓	✓
Reservoir flooding	x	x
Coastal flooding	x	x

General approach

14.5.3 The Environmental Scoping Report (Highways England, 2020c) sets out the criteria which have been used to assess significance for this aspect.

14.5.4 The assessment of the proposed scheme's impact on RDWE follows that set out in Table 3.2 of DMRB LA 113 (Highways England, 2020a), augmented by professional judgement where required. The RDWE assessment considers the potential impact during construction and operation to the following:

- Surface water (quality, resources and hydromorphology)
- Groundwater (quality, levels, flows and GWDTEs)

- Flood risk

14.5.5 In addition, the assessment considers hydromorphological impacts, and compliance with the WFD Regulations. The assessment criteria for assessing the value of water environment receptors and the magnitude of impacts are included in the Environmental Scoping Report (Highways England, 2020c). The significance of effects has been assessed in line with Table 3.7 of DMRB LA 104 (Highways England, 2020d) (as outlined in Chapter 5: Environmental assessment methodology, of the Environmental Statement [TR010060/APP/6.1]).

14.5.6 As discussed in Chapter 5: Environmental assessment methodology, of the Environmental Statement [TR010060/APP6.1], the water environment can be impacted from multiple sources. Consideration of these combined impacts (intra-project effects) is an integral part of assessing the effect on the water environment. The assessment of significance therefore factors in all elements of the construction and operation of the proposed scheme that could impact the water environment.

14.5.7 For the purpose of the assessment of flood risk impacts, the proposed scheme has been classified as ‘Essential Infrastructure’.

Surface water quality

14.5.8 The DMRB LA 113 (Highways England, 2020a) standard supported by the HEWRAT Help Guide v2.0 (Highways England, 2015) contain the simple-level and detailed-level assessment methodology which has been followed to assess operational effects of routine runoff and accidental spillage risk on surface waters. The scope of these assessments is presented in the WQAR in Appendix 14.1 [TR010060/APP/6.3]. A simple-level assessment involves consideration of soluble pollutants in the long term based upon annual average concentrations which relate to EQS, and in the short term (i.e. acute), impacts over a six-hour or 24-hour period. Sediment-bound pollutants are also considered in the assessment process. The data used in the HEWRAT assessments are presented in Annex B and C of the WQAR (Appendix 14.1). Construction impacts upon surface water quality have also been included in the scope of the assessment.

14.5.9 A simple-level surface water quality assessment has initially been undertaken for routine runoff. For those outfalls that record HEWRAT EQS failures, based upon the data and design currently available and the embedded mitigation, further detailed assessment has been carried out. The Metal Bioavailability Assessment Tool (M-BAT) (Water Framework Directive – United Kingdom Technical Advisory Group (WFD-UKTAG), July 2014) has been adopted in accordance with DMRB LA 113. The M-BAT assessment has used Environment Agency data where appropriate. The M-BAT assessments, data and results are described in the WQAR (Appendix 14.1 [TR010060/APP/6.3]).

14.5.10 Where low flows have been identified as potentially occurring in a receiving watercourse, routine runoff could infiltrate to ground. Infiltration of routine runoff through watercourses presents a risk to groundwater quality depending upon the underlying geology. These receiving watercourses have been identified and

an assessment of risks to groundwater quality has been undertaken in line with the methodology in Appendix C of DMRB LA 113 and HEWRAT. The details of these assessments are included the WQAR (Appendix 14.1 of the Environmental Statement [TR010060/APP/6.3]).

14.5.11 The Environment Agency was consulted on surface water quality, active discharge consents and abstraction licences. Drainage strategy proposals and preliminary structures design information was also discussed with the Environment Agency through meetings held between June 2020 and December 2021.

Hydromorphology

14.5.12 The assessment of potential impacts on hydromorphology used a combination of guidance in DMRB LA 113 (Highways England, 2020a) and professional judgement to assess morphological changes within each watercourse scoped into the Environmental Assessment. The effects to construction and as a result of operation are considered, and recommendations of mitigation where practicable have also been included. The approach followed the simple assessment of hydromorphological change (as outlined in Appendix E of LA 113) informed by a combination of site survey and desk study.

14.5.13 The site survey identified baseline information on each watercourse, including channel form and character, sediment descriptors, flow processes, floodplain and riparian habitat, information on morphological and catchment-channel connectivity and examination of the setting of the watercourse within the wider catchment context.

14.5.14 Desk study assessment considered morphological changes to both the upstream and downstream sections of watercourses crossed, which have the potential to be affected by the road scheme. This included potential changes in the bed substrate and bedform, changes to fluvial processes both within the channel and adjacent floodplain zones and overall change to morphological continuity. The information from this assessment is included in the Hydromorphology Assessment (Appendix 14.3 [TR010060/APP/6.3]).

14.5.15 Information from this assessment was also used to inform the WFD Regulations detailed compliance assessment in Appendix 14.2 [TR010060/APP/6.3].

Groundwater

14.5.16 The assessment to determine the significance of effects for the groundwater environment, encompasses the following:

- Construction activities such as earthworks, piling and accidental spills and releases
- Groundwater levels and flows relating to altered drainage, permanent barriers or dewatering
- Groundwater quality, relating to routine runoff and spillage

- Secondary receptors such as GWDTEs or groundwater abstractions impacted by any of the above

14.5.17 The assessment is informed by conceptual site models (CSMs) presented in Appendix 14.4 [TR010060/APP/6.3], which are used to determine how the construction and operation of the proposed scheme could impact groundwater receptors, including variations over time and between construction and operation. The CSMs have been developed with both desk-based information and ground investigation information undertaken along the route and at the proposed borrow pit locations. This is consistent with the approach outlined in Appendix A of DMRB LA 113 (Highways England, 2020a). Some of the CSMs are very detailed, such as those that support GWDTE assessments; others are supported by semi-quantitative assessment such as for dewatering impacts.

14.5.18 Impacts relating to existing groundwater quality or impacts from contaminated land are covered in the land quality assessment in Chapter 10: Geology and soils, of the Environmental Statement [TR010060/APP/6.1].

14.5.19 Impacts relating to routine runoff and spillage are included in the WQAR (Appendix 14.1 [TR010060/APP/6.3]). The assessment has been undertaken in accordance with LA 113 Appendix C. It uses the HEWRAT groundwater tool to estimate the potential groundwater risk factors of each outfall discharging to low flow streams, and the predicted metal (Zn and Cu) concentrations pre- and post-mitigation.

14.5.20 For the dewatering assessment an initial screening was undertaken to assess the likelihood of the excavation to intercept groundwater. A conservative approach was undertaken using maximum excavation depths and shallowest groundwater elevations recorded during the recent ground investigation in the vicinity of the works. Following this, the Sichardt method (e.g. Preene *et al*, 2016) was used to estimate the zone of influence of dewatering around each of the cuttings, widenings and borrow pits considered likely to intercept groundwater, using the estimated drawdown of groundwater levels due to the excavation. The effect on receptors (including licensed and unlicensed groundwater abstractions, GWDTE, heritage assets and surface water receptors) was then assessed in relation to each proposed excavation.

14.5.21 The identification, prioritisation and impact assessment associated with GWDTE sites follows the UK Technical Advisory Group (UKTAG) guidance Draft Protocol for Determining ‘Significant Damage’ to a ‘Groundwater Dependent Terrestrial Ecosystem’ (UKTAG, 2005). A phased screening approach was followed, described in detail in Section 5 of Appendix 14.4 [TR010060/APP/6.3]. This identified nature and conservation areas by site visits carried out by ecologists and subsequently verified and complemented by specific GWDTE site walkovers. Following this screening assessment, CSMs for each GWDTE potentially impacted by the proposed scheme were established to categorise the likely degree of groundwater dependency at each location. These CSMs were the basis for determining potential changes in groundwater levels, flows and quality, which could result from the proposed scheme reflecting the type of development (i.e. cutting, embankment).

14.5.22 A preliminary settlement analysis has been undertaken using the estimated dewatering zones of influence and high-level prediction of drawdowns. This has identified where settlement of at least 10mm could occur within the scheme areas. This threshold has been adopted because less than 10mm is unlikely to cause differential settlement effects on buildings. The assessment identifies buildings located within the estimated zones of influence: listed buildings, heritage assets and normal buildings. The identification of heritage assets and normal buildings is aligned with Chapter 7: Cultural Heritage, of the Environmental Statement [TR010060/APP/6.1]. This preliminary assessment is included in Section 4 of Appendix 14.4 [TR010060/APP/6.3].

14.5.23 A review of potential water quality impacts on sensitive receptors such as groundwater abstractions and GWDTEs has been undertaken in cognisance of the surrounding topography, the distance to, and nature and characteristics of, the receptor. Details are provided in Section 5 and 6 of Appendix 14.4 [TR010060/APP/6.3] for GWDTEs and groundwater abstractions respectively.

Flood risk

14.5.24 The FRA has been produced in accordance with the technical guidance to the NPPF and demonstrates compliance with the requirements of the NNNPS, specifically that the proposed scheme would:

- remain operational and safe for users in times of flood
- not increase flood risk elsewhere.

14.5.25 The flood risk design criteria and requirements are included in the FRA (Appendix 14.5 [TR010060/APP/6.3]) and the Surface Water Drainage Strategy (Appendix 14.6 [TR010060/APP/6.3]). These were shared through consultation with the Environment Agency, Essex County Council (as the LLFA) and other relevant stakeholders.

14.5.26 The FRA demonstrates the proposed scheme's compliance with the NNNPS by including the following:

- An assessment of flood risk to the proposed scheme from all sources
- An assessment of change in flood risk from all sources as a result of the proposed scheme
- Appropriate allowances for climate change according to the latest published guidance
- An assessment of mitigation measures to prevent adverse impacts on flood risk
- Details of completion of the Sequential and Exception Tests

14.5.27 Hydraulic modelling of seven Main Rivers and five Ordinary Watercourses has been undertaken to confirm baseline fluvial flood risk, inform the design process and assess the impact of the proposed scheme. Liaison has been undertaken with the Environment Agency and Essex County Council (as the LLFA) to review the hydraulic models.

14.5.28 Climate change uplifts applied have been based on the latest available published Environment Agency guidance, given the design life of the proposed scheme, which are based on UK Climate Projections (Met office) 2018 (UKCP18) and 2009 (UKCP09) (the FRA provides further details of the climate change uplift values applied). The Environment Agency published an update to their guidance on the incorporation of the predicted impact of climate change to rainfall intensity in May 2022. Given the timing of the revised guidance being published, it will not be possible to incorporate it into the relevant DCO application documents and also ensure the application is submitted in a timely fashion (given the time it would take to update the relevant documents). However, it is proposed that the guidance will be considered post-submission (and ideally pre-examination), by way of a sensitivity test that will report the implications of the new guidance on the assessments undertaken to date. The results of this will be submitted to the examination and will, as necessary to reflect any updates, be the basis on which the detailed design of the scheme is undertaken, should the DCO be granted.

Assessing the significance of effects

14.5.29 Significance of effect has been derived through a combination of the importance of a receptor affected (value or importance) and the magnitude (amount of change). The water-specific criteria for determining importance and magnitude of impact are included in Tables 14.8 and 14.9 respectively. The result of this assessment is then combined to define the significance of effect as set out in Chapter 5: Environmental assessment methodology [TR010060/APP/6.1].

Table 14.8 Estimating the importance of water environment attributes (adapted from Table 3.70 of DMRB LA 113)

Value (importance)	Typical criteria	Typical descriptors	
Very high	Nationally significant attribute of high importance	Surface water	Watercourse having a WFD Regulations classification shown in a RBMP and $Q_{95} \geq 1.0m^3/s$ (see Section 14.8 of this chapter). Site protected/designated under EU or UK legislation (Special Area of Conservation (SAC), Special Protection Area (SPA), Site of Special Scientific Interest (SSSI), Ramsar site, salmonid water*) and species protected by EC legislation.
		Hydromorphology	A watercourse that appears to be in complete natural equilibrium and exhibits a natural range of morphological features. There is a diverse range of fluvial processes present, free from any modification or anthropogenic influence. Morphological features and processes would be highly sensitive to change as a result of temporary or permanent works.
		Groundwater	Principal bedrock and superficial aquifers. Groundwater flow and yield associated with licensed groundwater abstractions. Groundwater quality associated with Source Protection Zone (SPZ) 1 (Inner Protection Zone) associated with licensed abstractions. Buildings of regional or national importance, such as Grade I listed buildings, scheduled monuments, hospitals, power stations and large industrial sites whose foundations could be affected by changes to groundwater levels and/or flows. Water feeding GWDTEs with a high or moderate groundwater dependence with a high environmental importance and international or national value, such as Ramsar sites, SACs, SPAs and SSSIs.
		Flood risk	Essential infrastructure or highly vulnerable development** (e.g. essential transport infrastructure (the proposed scheme has been classified as ‘essential infrastructure’) which must cross the area at risk).

Value (importance)	Typical criteria	Typical descriptors	
High	Locally significant attribute of high importance	Surface water	Watercourses having a WFD Regulations classification shown in a RBMP and Q_{95} <1.0m^3/s.
		Fluvial geomorphology	A watercourse that appears to be in natural equilibrium and exhibits a natural range of morphological features. There is a diverse range of fluvial processes present, with very limited signs of modification or other anthropogenic influences. Morphological features and processes would be sensitive to change as a result of temporary or permanent works.
		Groundwater	Secondary A aquifers. Groundwater flow and yield and quality associated with extensive non-licensed private water abstractions (i.e. feeding ten or more properties or supplying large farming / animal estates). Groundwater quality associated with SPZ2 (Outer Protection Zone) associated with licensed abstractions. Residential and commercial properties and Grade II listed buildings. Water feeding GWDTEs of low groundwater dependence with a high environmental importance and international or national value, such as Ramsar sites, SACs, SPAs and SSSIs; or water feeding highly or moderately GWDTEs with a national non-statutory UK Biodiversity Action Plan (BAP) priority.
		Flood risk	More vulnerable development** (e.g. residential properties, other residential institutions, hospitals and non-residential uses for health services, nurseries and educational establishments).

Value (importance)	Typical criteria	Typical descriptors	
Medium	Of moderate quality and rarity	Surface water	Watercourses not having a WFD Regulations classification shown in a RBMP and Q_{95} >0.001m^3/s.
		Hydromorphology	A watercourse showing signs of modification, recovering to a natural equilibrium, and exhibiting a limited range of morphological features (such as pools and riffles). The watercourse is one with a limited range of fluvial processes and is affected by modification or other anthropogenic influences. Morphological features and processes could be sensitive to change as a result temporary or permanent works.
		Groundwater	Secondary B and Secondary Undifferentiated aquifers. Groundwater flow and yield and quality associated with small-scale private water abstractions (i.e. feeding fewer than ten properties). Groundwater quality associated with SPZ3 (associated with licensed abstractions and unlicensed abstractions for which no SPZ is defined. Unoccupied residential and commercial properties and buildings. Water feeding GWDTEs of low groundwater dependence with a national non-statutory UK BAP priority; or water feeding highly or moderately groundwater dependent GWDTE sites with no conservation designation.
		Flood risk	Less vulnerable development** (e.g. buildings used for shops, offices, storage and distribution, restaurants).
Low	Lower quality	Surface water	Watercourses not having a WFD Regulations classification shown in a RBMP and Q_{95} ≤0.001m^3/s.
		Hydromorphology	A highly modified watercourse that has been changed by channel modification or other anthropogenic pressures. The watercourse exhibits no morphological diversity and has a uniform channel, showing no evidence of active fluvial processes and not likely to be affected by modification.

Value (importance)	Typical criteria	Typical descriptors	
		Groundwater	Very poor groundwater quality and/or very low permeability make exploitation of groundwater unfeasible. No active groundwater supply. Industrial buildings that are currently not utilised, all derelict buildings and infrastructure that serves a single dwelling whose foundations could be affected by changes to groundwater levels and/or flows. Water feeding GWDTEs of low groundwater dependence with no designation; or groundwater that supports a wetland not classified as a GWDTE, although may receive some minor contribution from groundwater.
		Flood risk	Water-compatible development** (e.g. flood control infrastructure, water/sewage transmission infrastructure and pumping stations, amenity open space, nature conservation and biodiversity, outdoor sports and recreation).

* Salmonid terminology found in 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 WFD Regulations. As such the 'designated salmonid/cyprinid fisheries' now no longer exists and watercourses either have fish as a biological quality element or not. The presence of fish as a biological quality element for watercourses has not been considered when determining value to avoid duplication of effects with the biodiversity assessment.

** Vulnerable development, less vulnerable development and water-compatible development are defined in the Flood Risk section of the Technical Guidance to the NPPF (MHCLG, 2021).

Table 14.9 Estimating the magnitude of an impact on a water environment attribute (adapted from Table 3.71 of DMRB LA 113)

Magnitude	Criteria	Typical descriptors	
Major adverse	Results in loss of attribute and/or quality and integrity of the attribute	Surface water quality	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). Loss of regionally important public water supply. Loss or extensive change to a designated nature conservation site. Reduction in water body WFD Regulations classification.
		Groundwater	Major or irreversible change to groundwater aquifer(s) flow, water level, quality or available yield which endangers the resources currently available. Groundwater resource use / abstraction is irreparably impacted upon, with a major or total loss of an existing supply or supplies. Changes to water table level or quality would result in a major or total change in, or loss of, a groundwater dependent area, where the value of a site would be severely affected. Changes to groundwater aquifer(s) flow, water level and quality would result in major changes to groundwater baseflow contributions to surface water and/or alterations in surface water quality, resulting in a major shift away from baseline conditions such as change to WFD Regulations status. Dewatering effects create significant differential settlement effects on existing infrastructure and buildings leading to extensive repairs being required.
		Fluvial geomorphology	Loss or extensive damage to habitat due to extensive modification of natural channel planform, and/or sediment and flow processes. Replacement of a large extent of the natural bed and/or banks with artificial material.
		Flood risk	Increase in peak flood level* (>100mm).

Magnitude	Criteria	Typical descriptors	
Moderate adverse	Results in effect on integrity of attribute, or loss of part of attribute	Surface water quality	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. Degradation of regionally important public water supply or loss of major commercial, industrial or agricultural supplies. Contribution to reduction in water body WFD Regulations classification.
		Groundwater	Moderate long-term or temporary significant changes to groundwater aquifer(s) flow, water level, quality or available yield which results in moderate long-term or temporarily significant decrease in resource availability. Groundwater resource use / abstraction is impacted slightly, but existing supplies remain sustainable. Changes to water table level or groundwater quality would result in partial change in or loss of a groundwater dependent area, where the value of the site would be affected, but not to a major degree. Changes to groundwater aquifer(s) flow, water level and quality would result in moderate changes to groundwater baseflow contributions to surface water and/or alterations in surface water quality, resulting in a moderate shift from baseline conditions upon which the WFD Regulations status rests. Dewatering effects create moderate differential settlement effects on existing infrastructure and buildings leading to consideration of undertaking minor repairs.
		Fluvial geomorphology	Moderate deterioration from baseline conditions, with partial loss or damage to habitat due to modifications and/or changes to natural fluvial forms and processes. Replacement of the natural bed and/or banks with artificial material.
		Flood risk	Increase in peak flood level* (50-100mm).

Magnitude	Criteria	Typical descriptors	
Minor adverse	Results in some measurable change in attributes, quality or vulnerability	Surface water quality	Failure of either acute soluble or chronic sediment-related pollutants in HEWRAT. Calculated risk of pollution from spillages ≥0.5% annually and <1% annually. Minor effects on water supplies.
		Groundwater	Minor changes to groundwater aquifer(s) flow, water level, quality or available yield leading to a noticeable change, confined largely to the proposed scheme area. Changes to water table level, groundwater quality and yield result in little discernible change to existing resource use. Changes to water table level or groundwater quality would result in minor change to groundwater dependent areas, but where the value of the site would not be affected. Changes to groundwater aquifer(s) flow, water level and quality would result in minor changes to groundwater baseflow contributions to surface water and/or alterations in surface water quality, resulting in a minor shift from baseline conditions (equivalent to minor but measurable change within WFD Regulations status). Dewatering effects create minor differential settlement effects on existing infrastructure and buildings that may need to be monitored but where repairs may be avoidable.
		Fluvial geomorphology	Slight deterioration from baseline conditions, with partial loss/damage to habitat due to modifications and/or changes to natural fluvial forms and processes.
		Flood risk	Increase in peak flood level* (10-50mm).
Negligible	Results in effect on attribute, but of insufficient magnitude to affect the use or integrity	Surface water quality	No risk identified by HEWRAT (pass both acute-soluble and chronic sediment-related pollutants). Risk of pollution from spillages <0.5%.
		Groundwater	Very slight change from groundwater baseline conditions approximating to a ‘no change’ situation. Dewatering effects create no or no noticeable differential settlement effects on existing infrastructure and buildings. No change situation would be discernible change from groundwater baseline conditions or no impact predicted on groundwater receptors from construction or operational effects of the scheme.

Magnitude	Criteria	Typical descriptors	
		Fluvial geomorphology	Very slight change from surface water baseline conditions, approximating to a 'no change' situation.
		Flood risk	Negligible change to peak flood level* (≤ +/- 10mm).
Minor beneficial	Results in some beneficial effect on attribute or a reduced risk of negative effect occurring	Surface water quality	HEWRAT assessment of either soluble or sediment-bound pollutants becomes a 'pass' from an existing baseline of a 'fail' condition. Calculated reduction in existing spillage risk by 50% or more (when existing spillage is <1% annually).
		Groundwater	Reduction of groundwater hazards to existing structures. Reductions in waterlogging and groundwater flooding.
		Fluvial geomorphology	Slight improvement of baseline conditions through partial improvement/gain in riparian or in-channel habitat. Slight diversification of flow processes and/or sediment processes.
		Flood risk	Creation of flood storage and decrease in peak flood level* (10-50mm).
Moderate beneficial	Results in moderate improvement of attribute quality	Surface water quality	HEWRAT assessment of both soluble and sediment-bound pollutants becomes a 'pass' from an existing baseline of a 'fail' condition. Calculated reduction in existing spillage risk by 50% or more when existing spillage is >1% annually). Contribution to improvement in water body WFD Regulations classification.
		Groundwater	Contribution to improvement in water body WFD Regulations classification. Improvement in water body catchment abstraction management strategy (or equivalent) classification. Support to significant improvements in damaged GWDTE.
		Fluvial geomorphology	Moderate improvement from baseline conditions, with partial creation of both in-channel and riparian habitat. Removal of existing superfluous structure or artificial channel bed/bank. Moderate diversification of flow processes and/or sediment processes.

Magnitude	Criteria	Typical descriptors	
		Flood risk	Creation of flood storage and decrease in peak flood level* (50-100mm).
Major beneficial	Results in major improvement of attribute quality	Surface water quality	Removal of existing polluting discharge or removing the likelihood of polluting discharges occurring to a water body. Improvement in water body WFD Regulations classification.
		Groundwater	Recharge of an aquifer. Improvement in water body WFD Regulations classification.
		Fluvial geomorphology	Extensive enhancement in-channel habitat and/or riparian habitat, as well as diversification of flow and sediment processes. Removal of an existing superfluous structure or artificial channel bed/bank. Extensive diversification of flow processes and/or sediment processes.
		Flood risk	Creation of flood storage and decrease in peak flood level* (>100mm).
No change	No loss or alteration of characteristics, features or elements; no observable impact in either direction.		

*All references to peak flood level are for a 1% (1 in 100) Annual Exceedance Probability (AEP) event plus allowance for climate change

14.6 Assessment assumptions and limitations

Scheme design and limits of deviation

14.6.1 For the groundwater assessment, vertical limits of deviation of 1m have been applied to infrastructure elements of the work (except for junction 24, where a deviation of 1.5m applies). Dewatering screening assessments for new offline cuttings and widenings have been based on excavation 1.5m lower than pavement levels to account for limits of deviation and an allowance for construction overdig.

14.6.2 It is possible that the size of the drainage catchments per outfall could change following the receipt of additional drainage survey data and updated drainage design as the proposed scheme progresses.

14.6.3 In respect to flood risk and hydromorphology, the assessment has been carried out on the proposed scheme as described in Chapter 2: The proposed scheme, of the Environmental Statement [TR010060/APP/6.1]. Any changes to the design, as a result of the limits of deviation, would only occur if they do not lead to any materially new or materially different environmental effects in comparison to those reported in the Environmental Statement.

Surface water quality

14.6.4 All SuDS and drainage networks would be fully maintained and managed as per standard National Highways and/or Essex Highways guidance and practice in accordance with the SuDS Manual C753 (Construction Industry Research and Information Association (CIRIA), 2015a). Requirements for maintenance and management of vegetated drainage systems are described in the Surface Water Drainage Strategy (Appendix 14.6 [TR010060/APP/6.3]).

14.6.5 The identification of embedded mitigation for water quality has not taken into account constraints or the presence of Statutory Undertakers' apparatus, access and maintenance requirements.

14.6.6 The assumptions and limitations relating to the HEWRAT and M-BAT assessments are presented in Appendix 14.1 [TR010060/APP/6.3].

14.6.7 The assessment is based on the available water quality data provided by the Environment Agency (2020 and 2021).

14.6.8 It is unclear whether the surface water licensed abstractions recorded in the 2016 Landmark report and not held by the Environment Agency have become inactive. To ensure that no surface water abstraction is omitted in this assessment, the licensed abstractions recorded in 2016 have been assumed to still be active.

14.6.9 Determination of Q_{95} low flows (i.e. the flow predicted to be exceeded 95% of the time) has been calculated by a desk-based exercise using catchment data and Wallingford Hydrosolutions Ltd LowFlows software. These are estimates of the Q_{95} flow and do not take account of the increasing proportional variability between the natural flow and the artificial influences, such as abstractions, discharges and storage changes as the river flow diminishes. However, these are the most robust data available to inform the assessment.

14.6.10 Estimates of channel dimensions and characteristics used in the assessments have been informed by photographs taken during ecological site visits from online aerial imagery and formal topographical surveys.

14.6.11 The expected treatment performance of different SuDS options is based on advice reported in DMRB CG 501 (Highways England, 2020e) and DMRB CD 532 (Highways England, 2020f).

14.6.12 The routine runoff and spillage water quality risk assessment is based on traffic data modelled for the proposed scheme which is included in Appendix 14.1 [TR010060/APP/6.3]. Assumptions used in the traffic modelling are not reported in this chapter; however further details regarding the data are presented in the Transport Assessment [TR010060/APP/7.2].

14.6.13 Existing outfalls used within the assessment have been established using drainage surveys, the National Highways Drainage Data Management System (HADDMS), local topography and the presence of watercourses from OS mapping (see Appendix 14.6 [TR010060/APP/6.3]).

14.6.14 The study area for assessing potential impacts to ponds (defined in Section 14.7 of this chapter) has been limited to 250m. Beyond this, ponds are assumed not to have a hydrological pathway with the proposed scheme.

Hydromorphology

14.6.15 The assessment of hydromorphological impacts to Main Rivers within the study area has been informed by site walkovers and desk studies. The Ordinary Watercourses assessment was a wholly desk-based study.

14.6.16 River realignments would take place separately to the construction of drainage culverts. The culvert would be constructed prior to the watercourse realignment which would tie-in to the culvert. Any planting or landscaping would take place following the completion of the realignment. This would also apply to other works to the mainline (online and offline), junctions and side roads which could affect a particular watercourse. Main rivers would be realigned offline from works and would then be tied-in with the active watercourse following the construction or extension of specific culverts and watercourse crossings at that particular watercourse. If working in the watercourse is unavoidable, it is assumed that hydrological continuity would be maintained via other means such as fluming, piping or if necessary, overpumping.

14.6.17 Construction surface water drainage discharge rates would be planned to mitigate risks associated with heavy rainfall events and flood events. Furthermore, discharge rates would be based on catchment size, topography and duration of works (see the first iteration EMP [TR010060/APP/6.5]). Measures would be in place to dissipate energy and reduce the risk of localised scour at the temporary outfalls.

14.6.18 Limiting discharge rates at outfalls would vary depending on the nature of the catchment drained. As the proposed scheme has additional offline highways and junctions, surface water drainage is likely to increase and must be restricted to mitigate for the potential increased risk of flood events. Flow rates are determined by calculating greenfield runoff rates (for offline highways and junctions) and brownfield runoff rates (online highways and junctions). Flow

would be restricted to 5l/s as the minimum allowable discharge rate, as per Environment Agency guidance, by attenuation storage such as ponds.

14.6.19 Where watercourse reaches are to be abandoned following realignment, it is assumed that the construction of these realignments would take place in isolation to the existing watercourse. Therefore, no flow would be present along the excavated channel until the existing channel had been abandoned.

14.6.20 Outfalls would be installed or constructed set back from watercourses. Once constructed, the watercourse banks situated in front of the headwall would be excavated to connect the outfall to the receiving watercourse and increase riparian habitat.

14.6.21 Where the gas main diversion crosses a Main River, trenchless crossing would be used. Where the gas main diversion crosses Ordinary Watercourses, it is assumed for this assessment that an open cut trench would be used.

Groundwater

14.6.22 Estimated dewatering zones of influence and drawdown are based on simple calculations designed to provide a conservative steady-state assessment. This is likely to overestimate the impacts of the dewatering required for cuttings, widenings and borrow pits, particularly in permeable strata. Strata types are assumed to be continuous within the zone of influence whereas the geology often varies laterally across the proposed scheme.

14.6.23 The identification of potential GWDTEs is based on Phase 1 Habitat mapping. No National Vegetation Classification (NVC) surveys were undertaken.

14.6.24 Lists of unlicensed abstractions of less than 20m^3/d were provided by Chelmsford Borough Council in December 2020, however it should be noted that records may not record all private abstractions.

14.6.25 Groundwater licensed abstractions recorded in the 2016 Envirocheck report (Landmark, 2016) and not listed by the Environment Agency in 2021 (Environment Agency, 2016) may have become inactive. However, to ensure that no groundwater abstraction is omitted in this assessment, all the licensed abstractions recorded in 2016 have been assumed to be still active and have been considered in the assessments.

14.6.26 In accordance with DMRB guidance (LA113), outfalls to low-flow streams could infiltrate to groundwater and hence have been assessed using the HEWRAT groundwater tool.

14.6.27 Research undertaken by National Highways in collaboration with the Environment Agency concluded that dissolved Polyaromatic Hydrocarbons (PAHs) are not classified as ‘significant pollutants’. Hydrocarbons are therefore not considered to be contaminants of concern for the routine runoff assessment for groundwater (Highways England, 2010).

14.6.28 No information has been provided by Anglian Water on the Messing-cum-Inworth Public Water Supply associated with the SPZ1 at Inworth Road. However, the Environment Agency have confirmed that the licence for this location was not renewed in 2016. The Environment Agency also indicated they would be removing the Source Protection Zone associated with this abstraction

from their database. This abstraction has therefore not been included in the assessment.

14.6.29 Geological maps and/or historical British Geological Survey (BGS) records were used to assess the geology where there were no ground investigation data. Three phases of exploratory ground investigation were undertaken along the scheme route, largely along the line of the proposed scheme and within the areas of the borrow pits, including groundwater level monitoring.

14.6.30 Groundwater monitoring and strike data were used to provide a preliminary conservative assessment of depths to water, using the shallowest depth encountered. Due to the linear nature of the investigation, groundwater flow directions are largely based on topography and location of surface water bodies.

14.6.31 In some cases, groundwater level information is limited to groundwater strikes and seeps recorded in borehole logs provided by the BGS, as no ground investigation boreholes are located within the vicinity.

14.6.32 Groundwater monitoring data up to September 2021 have been included in the assessment. Ongoing groundwater monitoring is not required for this Environmental Statement assessment and will inform later stages of the proposed scheme.

14.6.33 Literature-based publicly available data have been used to support the majority of the assessments including locations of key groundwater receptors. It is assumed that these data are accurate and up to date.

14.6.34 The following assumptions and limitations have been made in relation to the design:

- The detailed drainage design for the proposed scheme was not known at the time of writing and the preliminary highway drainage design and assumptions have been used in this assessment. For the purpose of this assessment, it is conservatively assumed that all attenuation ponds would be constructed to a maximum of 2m bgl. It is thought that the majority of ponds would be less than 1.5m deep.

- Preliminary ground investigations undertaken for the proposed attenuation pond locations indicate potential use of infiltration techniques would not be feasible due to the generally low porosity to practically impervious ground conditions. The preliminary GI also indicates shallow groundwater and potential contaminated land presence at some proposed attenuation pond locations that would require measures such as pond lining. As such it is assumed that infiltration to ground from the proposed scheme highway drainage would not be possible. This provides a conservative approach to the pond size with respect to land take requirements. Detailed assessment may be required following completion of the detailed drainage design and this assumption may alter as the ground investigation progresses.

- The estimated depths of the proposed retaining walls have been assumed to be 4.5 times the maximum retained height.

- Piling and foundation designs are not finalised. Preliminary designs provide estimated piling depths for new bridges, and bridges requiring widening. No pile depths are available for cantilevered gantries at the time of writing.

Flood risk

14.6.35 Information regarding baseline flood risk has been obtained from desk-based sources, available ground investigation information and hydraulic modelling outputs. Hydraulic modelling has been completed to assess fluvial flood risk and inform the FRA (Appendix 14.5 [TR010060/APP/6.3]). This hydraulic modelling includes the appropriate climate change allowances in accordance with Environment Agency guidance last updated in 2021 (Environment Agency, 2021d). The Environment Agency published an update to their guidance on the incorporation of the predicted impact of climate change to rainfall intensity in May 2022. Given the timing of the revised guidance being published, it will not be possible to incorporate it into the relevant DCO application documents and also ensure the application is submitted in a timely fashion (given the time it would take to update the relevant documents). However, it is proposed that the guidance will be considered post-submission (and ideally pre-examination), by way of a sensitivity test that will report the implications of the new guidance on the assessments undertaken to date. The results of this will be submitted to the examination and will, as necessary to reflect any updates, be the basis on which the detailed design of the scheme is undertaken, should the DCO be granted.

14.6.36 The assessment of groundwater flood risk presented in this Environmental Statement is based on desk study information (which includes BGS groundwater flooding susceptibility maps) and ground investigation data.

14.6.37 Where culvert crossings of the proposed scheme are considered unlikely to cause flood risk to the scheme or local receptors, the Risk of Flooding from Surface Water mapping (RoFSW) (Environment Agency, 2021g) is considered to sufficiently represent the risk associated with Ordinary Watercourses (further details are included in Appendix 14.5 [TR010060/APP/6.3]). The RoFSW mapping does not take climate change into account for the 1% (1 in 100) AEP flood event so instead, the 0.1% (1 in 1,000) AEP RoFSW mapping has been adopted as a proxy for an assumed 1% (1 in 100) AEP plus climate change flood event extent.

14.6.38 There are uncertainties and limitations inherent in hydraulic modelling. For example, where topographical survey of ground elevation is not currently available, lower resolution Light Detection and Ranging (LiDAR) data have been used instead. The FRA (Appendix 14.5 [TR010060/APP/6.3]) provides additional details of hydraulic modelling assumptions and limitations.

14.6.39 Where hydraulic modelling has not been undertaken, it is not always possible to estimate the magnitude of change in flood depths that a specific impact may cause. Where this is the case, professional judgement has been used to estimate potential changes in flood depth, with depth changes assumed to be of major adverse magnitude where levels of uncertainty are considered too high to make more detailed assessment.

14.6.40 For the purposes of defining a value for importance of receptors, it has been assumed that B-roads such as the Inworth Road B1023 are 'essential infrastructure'.

14.6.41 A design life of 100 years has been assumed for the scheme to determine the appropriate allowances to be applied, to incorporate the predicted impact of climate change.

14.6.42 It is assumed that where private means of access routes, haul roads and temporary roads, would cross areas of floodplain, existing ground levels would be maintained where practicable.

14.6.43 It is assumed that, where additional permanent watercourse crossings are identified as being required, they would be designed to pass the 1% (1 in 100) AEP plus 40% allowance for climate change to ensure no significant effect on flood risk.

14.7 Study area

14.7.1 The study area for the RDWE aspect has been based on professional judgement and defined by applying a 1km buffer around the Order Limits of the proposed scheme (see Figure 14.1 [TR010060/APP/6.2]). This distance identifies receptors that could reasonably be affected by direct impacts associated with the proposed scheme (e.g. via a pathway between the proposed scheme and a water body). In this way impacts that may occur beyond the 1km extent would be considered. In addition, there are RDWE element-specific considerations that have informed this distance:

- The HEWRAT Help Guide v2.0 (Highways England, 2015) states that outfalls that discharge within 1km of each other along the same reach of a watercourse should be assessed for cumulative impacts. For ponds this study area has been reduced to 250m as beyond this, ponds are assumed not to have a hydrological pathway with the proposed scheme.
- Due to the relatively low importance of the hydrogeological conditions (up to Secondary A aquifers for superficial deposits and the bedrock being almost entirely defined as unproductive strata), a study area of 1km is considered appropriate. However, where dewatering impacts are predicted over 1km from the proposed scheme, then impacts to receptors over 1km have been assessed.
- For the assessment of flood risk impacts, the study area of 1km has been revised locally at each watercourse as required to ensure that all flood risk impacts are considered.

14.8 Baseline conditions

Baseline sources

14.8.1 The baseline conditions have been established based on the following sources:

- Aerial imagery (Google Earth, 2021)

- Anglian River Basin Management Plan and Annexes (Environment Agency, 2016)
- BGS Susceptibility to Groundwater Flooding mapping (BGS, 2021b)
- BGS Geological maps (1:10,000 and 1:50,000 scale), borehole logs, and permeability index/aquifer properties datasets (where required) available at the BGS GeoIndex website (BGS, 2021a) or via an information request
- Braintree and Witham Surface Water Management Plan and modelling outputs (AECOM, 2016a)
- Braintree District Council Level 1 Strategic Flood Risk Assessment (SFRA) Update (AECOM, 2016b)
- Chelmsford City Council Level 1 and Level 2 SFRA (JBA Consulting, 2018)
- Colchester Borough Council Level 1 and Level 2 SFRA Update (AECOM, 2016c; 2017)
- Output report from EHS Data Limited database on unlicensed water supplies (Chelmsford Borough Council). Report prepared 19 November 2021 at 2pm
- Contemporary Ordnance Survey maps, (Ordnance Survey, 2021)
- Cranfield University, National soils mapping (2021)
- Detailed River Network Mapping (Environment Agency, 2021i)
- DMRB CG 501 Design of highway drainage systems (Highways England, 2020e)
- Drainage CCTV survey (Jacobs, 2020b)
- Envirocheck report (ref. 87509587_1_1, dated 25 May 2016) for the A12 between junctions 19 and 25
- Environment Agency Catchment Data Explorer (Environment Agency, 2021b)
- Environment Agency Flood Map for Planning (Environment Agency, 2021c)
- Environment Agency Historic Flood Map (Environment Agency, 2021e)
- Environment Agency Long Term Flood Risk Information Mapping (Environment Agency, 2021f)
- Environment Agency Risk of Flooding from Reservoirs (Environment Agency, 2020b)
- Environment Agency Risk of Flooding from Surface Water (RoFSW) Extent: 0.1, 1 and 3.3 percent annual chance (AEP) datasets (Environment Agency, 2021g)

- Geomorphological site survey (undertaken in June 2017)
- Groundsure report (Groundsure reference: Enviro-A12-A_250, dated 19 July 2018, HAGDMS No. 30508) specifically for junction 24 to junction 25
- Ground investigation reports. Factual reports of ground investigation (Phases 1 to 3 and associated monitoring reports). A12 Chelmsford to A120. Geotechnical Engineering Limited
- Highways Agency DDMS (Highways England, 2021a)
- Historical Ordnance Survey maps (National Library of Scotland, 2021)
- Landmark Information Group (2016). Envirocheck report (ref. 87509587_1_1, dated 25 May 2016) for the A12 between junctions 19 and 25
- Multi-Agency Geographical Information for Countryside (MAGIC) map (Defra, 2021)
- Mid-Essex Level 1 SFRA (Scott Wilson, 2007)
- Mid-Essex Level 1 SFRA, Appendix D Maldon Supplementary Report (Maldon District Council *et al*. 2008)
- OS Open Rivers dataset (Ordnance Survey, 2021)
- Q95 data (HR Wallingford Solutions, 2020)
- Statutory Main River Map (Environment Agency, 2020a)

14.8.2 The existing highway drainage information for the A12 between junction 19 and junction 25 has been obtained primarily from drainage surveys undertaken in 2021. Other sources of information related to existing highway drainage included: National Highways 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.

14.8.3 Three phases of ground investigation have been undertaken with the data collected from November 2019 (the commencement of the Phase 1) to September 2021 used to inform the Environmental Statement. Detailed information is presented in the Land Quality Risk Assessment included in Appendix 10.1 of the Environmental Statement [TR010060/APP/6.3].

14.8.4 The ground investigation comprised the following:

- Intrusive ground investigation, geological logging, chemical and geotechnical testing and installation of groundwater monitoring boreholes at selected locations.

- Measurement of groundwater levels in monitoring boreholes starting at different dates depending on the phases of GI (earliest start in January 2020 for Phase 1 GI locations) and up until September 2021, with the installation of groundwater level data loggers in selected boreholes.
- Groundwater sampling and chemical testing from selected boreholes (see Chapter 10: Geology and soils [TR010060/APP/6.1] for further details of the groundwater chemical testing).
- Permeability testing in selected boreholes (rising and falling head tests).
- Soakaway testing to aid the drainage design.

14.8.5 Hydraulic modelling of Main Rivers has been undertaken to inform the FRA where it is considered that the proposed scheme would have the potential to impact these watercourses or their associated floodplain. The following events have been modelled: 5% (1 in 20) AEP; 1% (1 in 100) AEP; and 1% (1 in 100) AEP event plus allowance for climate change. Model results have been used to establish the baseline fluvial flood risk from these watercourses.

14.8.6 The River Chelmer has not been modelled as part of the FRA as it is considered that the proposed scheme would have a negligible impact on the River Chelmer floodplain based on the Environment Agency's Flood Map for Planning (2021c) flood zone mapping. This mapping has therefore been used as the baseline and defines flood zones 2 and 3 as follows:

- Flood zone 3: areas with greater than a 1% (1 in 100) AEP of fluvial flooding
- Flood zone 2: areas with between 0.1% (1 in 1,000) and 1% (1 in 100) AEP of fluvial flooding

Baseline information

Surface water

14.8.7 The proposed scheme lies within the catchments of the River Blackwater and the River Colne. The River Blackwater has two major tributaries: the River Brain, which meets it just south of Witham, and the River Chelmer, which meets it just east of Maldon. The River Blackwater discharges into the Blackwater Estuary which in turn meets the North Sea to the west of Mersea Island.

14.8.8 The River Colne is a small river that passes through Colchester. It is not a tributary of any other river, instead having an estuary that joins the North Sea to the east of Mersea Island.

14.8.9 The proposed scheme crosses seven Main Rivers. These are Boreham Brook, River Ter, River Brain, Rivenhall Brook, River Blackwater, Domsey Brook and the Roman River. The watercourses crossed are summarised in detail in tabular format within the FRA (Appendix 14.5 [TR010060/APP/6.3]). There are approximately 36 Ordinary Watercourses crossed by the proposed scheme and numerous tributaries which would receive road runoff from the proposed scheme once operational. Tributaries of named watercourses have been given unique references for use within this assessment and are presented on Figure 14.1 [TR010060/APP/6.2].

14.8.10 There are numerous minor and unnamed drains and ditches within the study area, often associated with field boundaries. These have not been itemised in the assessment but have been considered as extensions of the named watercourses to which they are associated. Figure 14.1 [TR010060/APP/6.2] indicates the location of key watercourses and their tributaries, taken from digital OS maps.

14.8.11 There is a total of 76 ponds within the 250m study area. Figure 14.1 [TR010060/APP/6.2] shows the location of these ponds. Ponds that would either be physically impacted by the proposed scheme or where the water quality or hydrology could be impacted through hydrological connectivity, have been identified. Ponds within the study area are listed in the Hydromorphology Assessment (Appendix 14.3 [TR010060/APP/6.3]).

14.8.12 No further water bodies with hydraulic connectivity were identified from a review of OS mapping or site surveys, although there may be very minor drainage ditches that have not been identified, which have been assessed generically.

Surface water quality

14.8.13 The Anglian RBMP classifies WFD Regulations water bodies according to their ecological and chemical status and whether they have been heavily modified or not. Water bodies are required to achieve ‘good’ ecological and chemical status (or potential, if designated as heavily modified or artificial) by 2027. The status of each water body is outlined in the compliance assessment (Appendix 14.2 [TR010060/APP/6.3]).

14.8.14 All of the water bodies within the study area ‘fail’ for chemical status (Appendix 14.1 [TR010060/APP/6.3]). The failures, based upon 2019 published data, are mostly due to priority hazardous substances, notably:

- polybrominated diphenyl ethers (PBDE) and mercury and its compounds – failed by all water bodies
- perfluorooctane sulphonate (PFOS) – failed by the River Chelmer, River Brain, Blackwater (Combined Essex) water body and the Roman River
- tributyltin compounds – failed by the Blackwater (Combined Essex) water body
- cypermethrin (an insecticide and priority substance) – failed by the River Brain water body.

14.8.15 Vehicles and road runoff are not typically considered as significant sources of these pollutants, several of which are banned in the UK with pollution levels now due to historical uses.

14.8.16 Phosphate status is recorded as ‘poor’ in all water bodies with the exception of Boreham Tributary and Domsey Brook. Roads may contribute to phosphate levels through seasonal degradation of plant matter, soil and atmospheric deposition. However, wastewater treatment works and agriculture are likely to be the most significant sources of this pollutant, rather than highway runoff. Roman River also has ‘poor’ status for ammonia and ‘moderate’ status for dissolved oxygen.

14.8.17 There are other watercourses and unnamed tributaries and unnamed drains (see Figure 14.1 [TR010060/APP/6.2]) within the study area. These water bodies are not monitored by the Environment Agency for WFD Regulations reporting purposes and therefore their water quality status is unknown. It is assumed that these watercourses would face similar pollution pressures to the larger watercourses. Existing water quality in these smaller watercourses is likely to be influenced by surrounding land uses (which are predominantly residential and agricultural), surface water runoff, road drainage, sewerage misconnections, nutrient inputs from agriculture and golf courses, accidental spillages and unlicensed discharges. There is likely to be a significant network of surface water sewers which discharge into the watercourses listed above.

14.8.18 Data available on the Environment Agency Water Quality Archive website have been used in the assessment of water quality. The data used are presented in Annex B of Appendix 14.1 [TR010060/APP/6.3].

Hydrology and low flows

14.8.19 The Q_{95} value of a watercourse is the flow, in cubic meters per second, which is equalled or exceeded 95% of the time (based on flow records). This low-flow value is relevant when assessing effects on water quality as it is representative of a worst-case dilution scenario and is used to determine the value of receptors. Q_{95} values were obtained from HR Wallingford (December 2020) for 28 locations where the proposed scheme crosses the watercourses, and these are presented in Annex B of Appendix 14.1 [TR010060/APP/6.3]. All Q_{95} values were less than 1.0m^3/s.

Surface water drainage network

14.8.20 The existing surface water drainage within the proposed scheme extent incorporates the following edge collection features:

- Concrete surface water channels with catchpit gratings at regular intervals
- Kerb inlet gullies and traditional kerb / gully drainage arrangements
- Combined kerb drainage alignments
- Filter drains

14.8.21 In total, approximately 40 existing drainage outfalls have been identified. Further detail on the existing drainage within the scheme footprint is available in the proposed scheme Surface Water Drainage Strategy (Appendix 14.6 [TR010060/APP/6.3]).

14.8.22 The National Highways Priority Drainage (National Highways, 2021) assets programme classifies outfalls in accordance with their potential to pollute receiving waters. Outfalls can be classified as any of six categories which describe the level of risk to a receiving watercourse. Categories include A (very high), B (high), C (moderate), D (low), X (risk addressed) or ‘Not Determined’ for those lacking data. According to DDMS information, there are over 150 outfalls recorded within the proposed scheme extent. All the outfalls are Category C, D or ‘Not determined’. The Category C and D outfalls are recorded

as having had a baseline assessment only, based upon data that are not site-specific.

Abstraction licences

14.8.23 Information on licensed surface water abstractions within 500m of the proposed scheme was obtained from the Environment Agency in January 2021. The data indicate that there are 35 abstractions in this area, 26 of which are from surface water and nine from groundwater. The groundwater abstractions are discussed later in this baseline section.

14.8.24 The majority of the licensed water abstractions relate to agriculture (33), such as direct spray irrigation, with some abstractions for 'general farming and domestic' which have lower abstraction volumes. Other abstraction uses include golf courses (1) and use in unspecified industrial, commercial and public services (1). Based on the information available, abstractions are recorded on the River Blackwater, tributaries of the River Chelmer, and the River Ter and its tributaries.

14.8.25 An irrigation pipe is present under the A12, running between Colemans Reservoir and Rivenhall Oaks Golf Centre. This is used seasonally for irrigating the golf courses and is of critical importance to the viability of Rivenhall Oaks Golf Centre.

14.8.26 The majority of the study area falls within the Essex abstraction licensing strategy area. The Envirocheck Report (Landmark Information Group, 2016) recorded 18 surface water abstraction locations within the 1km study area, all for agricultural use). Three of these are located immediately adjacent to the existing A12. Further small-scale surface water abstractions could be present within the study area but not recorded within the Envirocheck report (Landmark Information Group, 2016). Some of these have been identified in information provided by the Environment Agency. Public consultation has also identified that some landowners are not connected to a mains water supply. This is discussed further in the groundwater section of this baseline.

14.8.27 It is acknowledged that there are abstractions downstream of the proposed scheme for public water supply that are located outside the study area. Existing Envirocheck data (Landmark Information Group, 2016) included three surface water public water supply points: two on the River Blackwater and one on the River Chelmer. These are approximately 5km downstream of the proposed scheme.

Water activity permits (discharge consents)

14.8.28 Envirocheck data (Landmark Information Group, 2016) record 27 environmental permits (surface water discharge consents) within the study area. These include miscellaneous discharges, sewage/sewerage discharges, surface water discharges, trade discharges and unknown discharges. Receiving watercourses are as follows:

- Rivenhall Brook and its tributary
- River Brain

- Tributary of River Chelmer
- Tributary of River Ter
- River Blackwater and its tributary
- Roman River and its tributary
- Boreham Brook and its tributary
- Tributary of Domsey Brook

Surface water dependent nature conservation sites

14.8.29 Marks Tey Brickpit SSSI is located within the study area; however, this is designated for its geological interest and thus has not been used to determine the value of water environment receptors or the magnitude of impact. The SSSI is described further in Chapter 10: Geology and soils, of the Environmental Statement [TR010060/APP/6.1].

14.8.30 Within the study area there are several nature conservation sites. This includes Brockwell Meadows Local Nature Reserve and Whetmead Local Nature Reserve. There are also numerous Local Wildlife Sites with surface water connections. Further details are presented in Chapter 9: Biodiversity, of the Environmental Statement [TR010060/APP/6.1].

14.8.31 Several drinking water safeguard zones (surface water) are located within the study area. These are designated areas in which the use of certain substances must be carefully managed to prevent the pollution of drinking water sources. These zones are areas where land use is causing pollution of raw water, typically from pesticides. Action is targeted in these zones so that extra treatment of raw water can be avoided. There are four surface water safeguard zones in the study area:

- SWSGZ1029 – between Chelmsford and Hatfield Peverel (directly passed through by the proposed scheme)
- SWSGZ1028 – between Hatfield Peverel and Marks Tey (directly passed through by the proposed scheme)
- SWSGZ1200 – between Marks Tey and Beacon End (directly passed through by the proposed scheme)
- SWSGZ1027 – north of Marks Tey (within study area but not passed through by the proposed scheme)

14.8.32 Nitrate vulnerable zones (NVZs) are areas designated as being at risk from agricultural nitrate pollution. Nitrate pollution is typically associated with agricultural land use and not related to highways. The study area falls within four surface water NVZs (2017 designations):

- Colne NVZ (directly passed through by the proposed scheme)
- River Blackwater NVZ (directly passed through by the proposed scheme)

- River Chelmer NVZ (directly passed through by the proposed scheme)
- Roman River NVZ (directly passed through by the proposed scheme)

Fisheries and water-dependent species

14.8.33 Two water bodies in the study area have been classified for fish under the WFD Regulations. The Roman River and the River Blackwater achieve 'High' and 'Moderate' status respectively for the fish element.

14.8.34 Aquatic surveys were undertaken across five sites in 2017 and six sites in 2020 within the study area. The six sites were Boreham Brook, Domsey Brook, the River Blackwater, River Brain, River Ter and Roman River. Full details of the survey are presented in the survey reports included in Chapter 9: Biodiversity, of the Environmental Statement [TR010060/APP/6.1]. Across all survey sites in 2017 and 2020, four species of conservation interest were found:

- Brown trout (*Salmo trutta*)
- Bullhead (*Cottus gobio*)
- European eel (*Anguilla anguilla*)
- River/brook lamprey (*Lampetra planeri*)

14.8.35 The presence of brown trout across all survey sites means these watercourses are classified as salmonid waters.

14.8.36 Fisheries using water bodies within the study area have also been identified. Those within the study area for ponds, lakes and reservoirs include the following:

- Colemans Cottage Fishery
- Bayeswater Fisheries

14.8.37 Colemans Reservoir is used as a leading coarse fishery with numerous large specimen fish contained within its waters.

Aquatic ecology

14.8.38 Details of the aquatic biodiversity baseline and potential impacts are presented in Chapter 9: Biodiversity, of the Environmental Statement [TR010060/APP/6.1].

14.8.39 A number of surveys have been carried out by the biodiversity team on water bodies surrounding the proposed scheme. This included surveys on populations of great crested newt (GCN), a European Protected Species. Existing records and surveys undertaken identified the presence of breeding GCN in 21 ponds within the study area.

Hydromorphology

14.8.40 Baseline conditions of hydromorphological receptors can be found in Appendix 14.3 [TR010060/APP/6.3]. These describe watercourses found within the study area which are hydrologically connected to the proposed scheme.

14.8.41 There are over 400 ponds within the 1km study area. The majority of these are offline features (i.e. not connected to a watercourse) and are not hydrologically connected to the proposed scheme. Therefore, they have been scoped out of the assessment. No ponds have been considered to offer any hydromorphological benefit and are of low importance. They are either used for irrigation via drainage channels, ornamental purposes, or for flood risk mitigation. The WQAR (Appendix 14.1 [TR010060/APP/6.3]) provides an overview of baseline conditions for each pond scoped into the assessment.

Groundwater

14.8.42 Detailed baseline groundwater information is presented in Section 2 of Appendix 14.4 [TR010060/APP/6.3]. A summary is presented in the following sections and groundwater receptors can be found on Figure 14.3 [TR010060/APP/6.2].

14.8.43 The study area is underlain by superficial deposits mainly comprising Head deposits, glaciofluvial deposits, Lowestoft Formation, Brickearth and localised Alluvium and River Terrace Deposits (BGS, 2021a). There are also localised deposits of glaciolacustrine materials and Kesgrave Catchment Subgroup.

14.8.44 Beneath the superficial deposits the study area is mainly directly underlain by London Clay, although the Thanet Sand Formation subcrops to the north of Witham while the Thanet Sand Formation and Lambeth group subcrop to the south-west of Kelvedon (BGS, 2021a). In these locations the London Clay is likely to be absent.

14.8.45 The mapped superficial deposits (Defra, 2021) are classified mainly as Secondary A and Secondary undifferentiated aquifers with pockets of Secondary B aquifer between junctions 19 and 20b (Hatfield Peverel North interchange). These aquifer designations are shown on Figure 14.2 [TR010060/APP/6.2].

14.8.46 The London Clay Formation which covers the majority of the site is unproductive strata and is thought to be relatively thick across the study area. Therefore it will offer significant protection to the underlying Secondary A and Principal aquifer (Chalk Group). The exception to this is where there are small outcrops of the Thanet and Lambeth groups within the centre of the study area classified as Secondary A aquifers.

14.8.47 Shallow groundwater present in the superficial deposits is expected to generally reflect the ground surface contours. Groundwater is expected to flow from the interfluves to the lower-lying valleys of the major rivers including the River Chelmer, River Brain, River Blackwater, Domsey Brook and Roman River.

14.8.48 Groundwater is likely to flow through the more permeable units such as the glaciofluvial and River Terrace Deposits. Within the Lowestoft Formation which is present across the majority of the study area (not necessarily at the surface), groundwater is likely to be found in discreet, isolated bodies within more permeable layers.

14.8.49 The local shallow groundwater may be connected (either directly or indirectly) to watercourses (as baseflow, sinks, sources, spreads, collects, issues), and spring discharges.

14.8.50 The groundwater SPZ map (Defra, 2021) shows that the section of the proposed scheme north of Kelvedon lies within a total catchment protection zone (SPZ3). This SPZ3 is associated with multiple Chalk abstractions to the north, the closest of which lies approximately 8km north-west of the proposed scheme. A further SPZ is defined for a public water supply abstraction 3km to the south of the Order Limits which abstracts from the shallow gravel aquifer. The SPZ3 for this abstraction extends to within 1km of the Order Limits.

14.8.51 Historically, there is a small SPZ1 associated with two public water supply boreholes situated on Inworth Road less than 10m from the proposed scheme. These were indicated to be licensed to Anglian Water in an Envirocheck report (Landmark Information Group, 2016). Recent searches of the Environment Agency datasets indicated that no licence was presented in 2021 and the Environment Agency have confirmed the licence was not renewed in 2016 and they will be removing the SPZ1 from their database.

14.8.52 In total, 45 licensed groundwater abstractions have been identified within 2km of the proposed scheme (Landmark Information Group, 2016). Eleven of these supplies are also shown on a more recent map of licensed abstractions produced by the Environment Agency. The majority of the locations are for domestic or agricultural use and are assumed active.

14.8.53 Groundwater abstractions of less than 20m^3/day do not require a licence. Colchester Borough Council has identified 13 groundwater abstractions within the study area although some have been identified as being located at the same coordinates as licensed abstractions. This suggests that they may relate to the same supply.

14.8.54 Initially, 34 potential GWDTEs were identified within the initial 1km screening buffer, from the Order Limits. This list was then refined to seven potential GWDTEs which are located directly within or adjacent to the Order Limits and likely to be impacted by the proposed scheme. Details on the identification, prioritisation and assessment of GWDTEs can be found in Section 5 of Appendix 14.4 [TR010060/APP/6.3].

14.8.55 Groundwater levels are generally present at shallow depth. The review of GI information is provided in Appendix 14.4.

14.8.56 The baseline groundwater quality is presented in Section 10.8 of Chapter 10: Geology and soils [TR010060/APP/6.1]. Locations where exceedances were recorded in groundwater quality samples are shown on Figure 10.1 [TR010060/APP/6.2]. Appendix 10.1 [TR010060/APP/6.3] presents the Land Contamination Risk Assessment which provides the factual groundwater analysis data.

Flood risk (including surface water drainage)

14.8.57 A full description of the flood risk baseline is presented in the FRA (Appendix 14.5 [TR010060/APP/6.3]).

Fluvial flood risk (Main Rivers)

14.8.58 Hydraulic modelling has been undertaken to inform the FRA (Appendix 14.5 [TR010060/APP/6.3]) which includes a full description of the baseline fluvial flood risk. The Main River flood extents derived from the hydraulic modelling for

the proposed scheme are considered to be more accurate than the Environment Agency's Flood Map for Planning (Environment Agency, 2021c). This is due to the improved resolution of the input data, use of topographic channel survey and recent hydrology assessments undertaken to inform the modelling. These have therefore been used to determine baseline fluvial flood risk.

14.8.59 Sheet 1 of Figure 14.4 [TR010060/APP/6.2] indicates Environment Agency flood zones for the River Chelmer. Sheets 2 to 11 of Figure 14.4 indicate predicted flood extents derived from the hydraulic models of Main Rivers that have informed the FRA.

Fluvial flood risk (Ordinary Watercourses)

14.8.60 Ordinary Watercourse is the term used to define all remaining rivers/watercourses within the UK not designated as Main Rivers. Activities on these watercourses are administered by the LLFA. The proposed scheme crosses approximately 36 Ordinary Watercourses (including proposed utilities diversions) (see Appendix 14.5, Annex M for a table of these [TR010060/APP/6.3]).

14.8.61 A preliminary assessment was undertaken for each of the Ordinary Watercourse crossings to determine the flow conditions through the structures. For this assessment, the Revitalised Flood Hydrograph (ReFH) method has been used to estimate the peak design flow for each watercourse crossing. Where the preliminary assessment suggested that the proposed scheme could have an adverse flood impact, or an existing flood risk to the A12 was identified, it was deemed that these watercourses should be hydraulically modelled to analyse these crossings in greater detail.

14.8.62 The preliminary assessment determined that for five Ordinary Watercourses (7, 21, 21a, 23, 26) hydraulic modelling would be required to inform the assessment of impact. Hydraulic modelling of these Ordinary Watercourses has been undertaken as part of the FRA. The following flood events have been modelled: 5% (1 in 20) AEP; 1% (1 in 100) AEP; and 1% (1 in 100) AEP event plus allowance for climate change (see Appendix 14.5 for details of climate change uplifts applied [TR010060/APP/6.3]).

14.8.63 Figure 14.4 [TR010060/APP/6.2] indicates the extent of the hydraulic models of the Ordinary Watercourses that have informed the FRA. The FRA provides a full description of the baseline fluvial flood risk associated with these Ordinary Watercourses in the vicinity of the proposed scheme.

14.8.64 For the Ordinary Watercourses which have not been hydraulically modelled, a review of the Detailed River Network (Environment Agency, 2021i), the RoFSW mapping (Environment Agency, 2021g), the Braintree and Witham Surface Water Management Plan modelling outputs (AECOM, 2016a), and the analysis undertaken as part of the drainage strategy for the proposed scheme has been undertaken to assess the baseline flood risk. The flood risk associated with these watercourses is detailed in the FRA.

14.8.65 The remainder of the study area is designated as flood zone 1 (less than 0.1% (1 in 1,000) AEP of flooding.

Surface water flood risk

14.8.66 Surface water (water accumulating and/or flowing across the ground surface) presents a risk within the study area based on the Detailed River Network mapping (Environment Agency, 2021i), the RoFSW mapping (2021g) and the Braintree and Witham Surface Water Management Plan modelling outputs (AECOM, 2016a) (see Figure 14.5 [TR010060/APP/6.2]).

14.8.67 There are areas shown to be at risk of surface water flooding immediately adjacent to all of the Main Rivers, but these areas are largely located within the fluvial floodplain extent associated with those watercourses. Therefore, the flood risk shown is likely to be associated with flows from these watercourses, and consequently is discussed in the fluvial flood risk sub-section above.

14.8.68 The RoFSW mapping (Environment Agency, 2021g) and Braintree and Witham Surface Water Management Plan mapping (AECOM, 2016a) have been reviewed. This has informed the assessment of the fluvial flood risk for the smaller watercourses not evident in the Environment Agency's Flood Map for Planning (2021c). These identify apparent overland flow routes that are actually associated with the Ordinary Watercourses identified.

14.8.69 Other areas of surface water flood risk are located mainly within localised topographic depressions or against existing road embankments. It should be noted that the high-level models often used for large-scale surface water mapping may not take full account of the influence of existing drainage and culverts and may therefore overestimate flood risk in some areas.

14.8.70 There are several significant overland flow routes and other areas of high surface water flood risk within the study area. The FRA (Appendix 14.5 [TR010060/APP/6.3]) provides further information on the location and extent of surface water flood risk across the study area.

Flooding from groundwater

14.8.71 Groundwater flooding occurs where water levels beneath the ground rise above the ground surface. In some instances, groundwater can emerge at surface level following heavy or prolonged rainfall events and can contribute to existing flooding from other sources.

14.8.72 BGS data (BGS, 2021a) show that across the central area of the scheme (Witham to Kelvedon), and in the very south and very north, the susceptibility to groundwater flooding is very high to moderate. In general, the northern area between Feering and Marks Tey has no susceptibility to groundwater flooding. There are some small areas in the south between Boreham and Hatfield Peverel and between Hatfield Peverel and the south of Witham where there is no susceptibility to groundwater flooding. However, around Hatfield Peverel the BGS mapping shows a moderate to high risk. Susceptibility to groundwater flooding is shown in Figure 14.6 [TR010060/APP/6.2].

14.8.73 In general across the proposed scheme, groundwater flood risk correlates with the nature of the mapped superficial deposits: more permeable units such as Alluvium, River Terrace Deposits and glaciofluvial deposits having a higher risk, while low-permeability units such as Head deposits and the Lowestoft Formation are usually not associated with groundwater flooding.

14.8.74 A review of groundwater monitoring undertaken as part of the ground investigation indicates that measured groundwater levels are typically within 6m of the ground surface, with the majority found within 2m of the surface indicating generally shallow groundwater conditions throughout the proposed scheme. There is no clear pattern to the distribution of the depth to groundwater levels across the scheme as a whole. This is a result of heterogeneity of the superficial materials and the discontinuous nature of some of the water-bearing layers.

14.8.75 The FRA provides further detail on groundwater flood risk across the study area including information on groundwater in the superficial deposits and bedrock groundwater.

Other flood sources

Water supply and sewer infrastructure

14.8.76 There is water supply and sewer infrastructure near the proposed scheme in various areas due to the location of residential and other properties (e.g. Chelmsford, Boreham, north of Hatfield Place, Hatfield Peverel, Witham, Rivenhall End, north of Essex County Fire and Rescue Service, south-east and north-east of Gore Pit, and Marks Tey).

14.8.77 No records of confirmed instances of sewer flooding have been included in the local SFRAs. Based on correspondence with Anglian Water it has been determined that no flood events due to water supply infrastructure failure have been recorded within the Order Limits. It is not considered realistic to attach a probability of collapse and/or failure to water supply and sewer infrastructure within the Order Limits as it would be dependent on multiple factors including their condition, existing maintenance regimes and other outside influences. However, it is considered a low risk, particularly as any flooding occurring from these sources would be anticipated to flow into scheme drainage.

Flood defence infrastructure

14.8.78 A review of the Environment Agency Flood Map for Planning (2021c) reveals that there is one area benefiting from flood defences located within the study area, to the east of Chelmer Village (see Figure 14.4 [TR010060/APP/6.2]). In this area the flood defence infrastructure is designed to protect a residential area within Chelmer Village from the River Chelmer, north-west of the existing A12 crossing of the River Chelmer. The proposed scheme would not interact with the flood defence infrastructure or with the area it defends. In the event of a failure of the defences, the area at risk of inundation would be the residential area to the west of the defences. The proposed scheme would not be at risk.

Canals

14.8.79 The Chelmer and Blackwater Navigation is the canalisation of the Rivers Chelmer and Blackwater in Essex. The Navigation connects Chelmsford with the tidal estuary of the River Blackwater. Flood risk from the Chelmer and Blackwater Navigation is considered within the fluvial flood risk sub-section and is therefore not considered elsewhere independently.

Future baseline

14.8.80 Climate change is likely to have the greatest impact on the baseline conditions of the water environment over the assumed 100-year lifetime of the proposed scheme.

Surface water

14.8.81 Climate change may lead to a change in both low and high flows in watercourses, leading to subsequent changes in dilution capacity. Land use changes and measures to improve watercourses in line with legislative objectives may also result in an improvement in baseline water quality.

Hydromorphology

14.8.82 Watercourses would likely adjust or migrate naturally, topography and land use permitting, irrespective of the proposed scheme. This is most likely to be the case for Main Rivers, which have increased hydromorphological function compared with (smaller) Ordinary Watercourses.

Groundwater

14.8.83 Future baseline conditions relating to climate change for groundwater include the potential for increased frequency and magnitude of groundwater flooding events

14.8.84 Groundwater flooding may be exacerbated where the events are linked to fluvial flooding and shallow, near-surface Secondary aquifers.

14.8.85 Reduced groundwater resource availability may arise due to increased groundwater demand from further development or agriculture and/or changes in groundwater recharge especially during prolonged dry periods exacerbated by climate change.

Flood risk

14.8.86 Climate change would likely increase the intensity of rainfall and consequently the frequency and magnitude of flood events.

14.8.87 The future baseline accounting for climate change has been assessed in line with the published Environment Agency guidance for increases in fluvial flows (based on UKCP18) and rainfall intensity (based on UKCP09). The Environment Agency published an update to their guidance on the incorporation of the predicted impact of climate change to rainfall intensity in May 2022. Given the timing of the revised guidance being published, it will not be possible to incorporate it into the relevant DCO application documents and also ensure the application is submitted in a timely fashion (given the time it would take to update the relevant documents). However, it is proposed that the guidance will be considered post-submission (and ideally pre-examination), by way of a sensitivity test that will report the implications of the new guidance on the assessments undertaken to date. The results of this will be submitted to the examination and will, as necessary to reflect any updates, be the basis on which the detailed design of the scheme is undertaken, should the DCO be granted. The FRA (Appendix 14.5 [TR010060/APP/6.3]) provides further details

of how future climate change has been considered in the assessment of flood risk.

Importance of receptors

14.8.88 The importance of all receptors within the study area has been assessed based on criteria in DMRB LA 113 (Highways England, 2020a) augmented with professional judgement. The assessment criteria are summarised in Table 14.8.

14.8.89 The Environmental Scoping Report (Highways England, 2020c) assumed an importance (described in that document as 'value') of medium for surface water quality for all unnamed watercourses as a precautionary approach in the absence of flow data. Since the Scoping Report, Q_{95} data have been obtained and calculated for the watercourses and these have been used to refine the importance for some of the unnamed watercourse receptors. Based upon these criteria (as per DMRB LA 113 guidance), 30 watercourses have been categorised as low importance receptors as presented in Table 14.10.

14.8.90 DMRB LA 113 does not include criteria for assessing the importance of ponds, lakes and reservoirs. As such, these have all been valued as low importance receptors unless they have specific uses and/or designations that would indicate increased importance.

Table 14.10 Importance of receptors in the study area for road drainage and the water environment

Importance	RDWE matter	Description	Examples within the study area
Very high	Surface water quality	Watercourse having a WFD Regulations classification shown in the River Basin Management Plan (RBMP) and a $Q_{95} \geq 1.0 m^3/s$.	No receptors of this value within the study area.
	Hydromorphology	A watercourse that appears to be in complete natural equilibrium and exhibits a natural range of morphological features (such as pools and riffles). There is a diverse range of fluvial processes present, free from any modification or anthropogenic influence.	No receptors of this value within the study area.

Importance	RDWE matter	Description	Examples within the study area
	Groundwater	Principal bedrock and superficial aquifers. Groundwater flow and yield associated with licensed groundwater abstractions. Groundwater quality associated with SPZ 1 (Inner Protection Zone) associated with licensed abstractions. Buildings of regional or national importance, such as Grade I listed buildings, scheduled monuments, hospitals, power stations and large industrial sites. Water feeding GWDTEs with a high or moderate groundwater dependence and a high environmental importance and international or national value, such as Ramsar sites, SACs, SPAs and SSSIs.	Upper and Middle Chalk (however located at depth underlying the study areas). One SPZ1 is located at Inworth Road although this is related to a historical abstraction licence, which is no longer present and hence the SPZ1 is no longer applicable. Various licensed groundwater abstractions LGA1, LGA2, etc (refer to Section 2 of Appendix 14.4 [TR010060/APP/6.3]. Scheduled monuments and Grade I listed buildings identified in dewatering zones of influence (refer to Section 4 of Appendix 14.4).
	Flood risk	Essential infrastructure or highly vulnerable development[1] e.g. essential transport infrastructure which must cross the area at risk (the proposed scheme has been classified as 'essential infrastructure').	Railway line within the study area to the north-east of junction 19. Existing A12.
High	Surface water	Watercourse having a WFD Regulations classification shown in RBMP and a Q95 <1.0m^3/s.	River Chelmer, River Blackwater, Roman River, Boreham Brook/tributary, Domsey Brook, River Brain, River Ter. Ponds confirmed to support great crested newts (see Chapter 9 – Biodiversity [TR010060/APP/6.1] for further details).

Importance	RDWE matter	Description	Examples within the study area
	Hydromorphology	A watercourse that appears to be in natural equilibrium and exhibits a natural range of morphological features. There is a diverse range of fluvial processes present, with very limited signs of modification or other anthropogenic influences. Morphological features and processes would be sensitive to change as a result of temporary or permanent works.	River Blackwater.
	Groundwater	Secondary A aquifers. Groundwater flow and yield and quality associated with extensive non-licensed private water abstractions (i.e. feeding ten or more properties or supplying large farming / animal estates). Groundwater quality associated with SPZ2 (Outer Protection Zone) and with licensed abstractions. Residential and commercial properties and Grade II listed buildings. Water feeding GWDTEs of low groundwater dependence with a high environmental importance and international or national value, such as Ramsar sites, SACs, SPAs and SSSIs; or water feeding highly or moderately GWDTEs with a national non-statutory UK BAP priority.	Secondary A aquifers: Glacio-fluvial/ glaciofluvial ice contact deposits, Alluvium, River Terrace Deposits, Kesgrave Catchment Subgroup, Lambeth Group and Thanet Sand. Default SPZ2 associated with licensed abstractions such as LGA-1, LGA-2, etc. Numerous residential and commercial properties within 1km of route. Grade II listed buildings identified in dewatering zones of influence (refer to Appendix 14.4 [TR010060/APP/6.3]).
	Flood risk	More vulnerable development[1] (e.g. residential properties, other residential institutions, hospitals and non-residential uses for health services, nurseries and educational establishments).	Residential properties, for example within Witham near the existing A12 River Brain crossing.

Importance	RDWE matter	Description	Examples within the study area
Medium	Surface water	Watercourse not having a WFD Regulations classification shown in RBMP and a Q_{95}>0.001m^3/s.	Rivenhall Brook, Ordinary Watercourses 13, 14, 16, 19, 32 and 37. P71 (Colemans Reservoir). P74 and P75 (Colemans Cottage Fisheries). P119 Bayeswater Fisheries.
	Hydromorphology	A watercourse showing signs of modification, recovering to a natural equilibrium, and exhibiting a limited range of morphological features (such as pools and riffles). The watercourse is one with a limited range of fluvial processes and is affected by modification or other anthropogenic influences. Morphological features and processes could be sensitive to change as a result temporary or permanent works.	Boreham Brook, River Chelmer, River Ter, River Brain, Domsey Brook, Roman River, Rivenhall Brook, Baddow Meads Ditch, Ordinary Watercourse 11.
	Groundwater	Secondary B and Secondary Undifferentiated aquifers. Groundwater flow and yield and quality associated with small-scale private water abstractions (i.e. feeding fewer than ten properties). Groundwater quality associated with SPZ3 (Source Protection Zone) associated with licensed abstractions. and unlicensed abstractions for which no SPZ is defined. Unoccupied residential and commercial properties and buildings. Water feeding GWDTEs of low groundwater dependence with a national non-statutory UK BAP priority; or water feeding highly or moderately groundwater dependent GWDTE sites with no conservation designation.	Secondary B/Undifferentiated aquifers: Lowestoft Formation (Glacial Till), Head, Brickearth. SPZ3: the northern section of the proposed scheme, north of Kelvedon, lies within a total catchment protection zone. Private groundwater abstractions such as PGA-1, PGA-2, etc (refer to Section 2 of Appendix 14.4 [TR010060/APP/6.3]). GWDTEs such as Wet Woodland 7 and Riverview Meadows Local Wildlife Site.

Importance	RDWE matter	Description	Examples within the study area
	Flood risk	Less vulnerable development[1] (e.g. buildings used for shops, offices, storage and distribution, restaurants).	Commercial properties within the study area, for example in Rivenhall End in proximity to the existing A12.
Low	Surface water quality	Watercourse not having a WFD Regulations classification shown in RBMP and a $Q_{95} \leq 0.001 m^3/s$.	Ordinary Watercourses 1 to 12, 12a, 13a, 15, 15a, 17, 18, 20, 21, 21a, 23, 24, 26, 28, 31, 31b, 33 to 36, 36b, 37b, 38 to 42. All other scoped-in ponds and lakes (that are not of Medium value).
	Hydromorphology	A highly modified watercourse that has been changed by channel modification or other anthropogenic pressures. The watercourse exhibits no morphological diversity and has a uniform channel, showing no evidence of active fluvial processes and not likely to be affected by modification.	Colemans Farm Ditch, Ordinary Watercourses 1B, 1a, 1, 2, 3a, 28, 28a, 7, 7A, 9, 9a, 10, 12, 13, 13a, 15, 15a,17, 18, 21, 21a, 23, 23a, 24, 24a, 26, 26a, 29, 29a, 29b and 30, all scoped-in ponds and lakes.
	Groundwater	Very poor groundwater quality and/or very low permeability make exploitation of groundwater unfeasible. No active groundwater supply. Industrial buildings that are currently not used, all derelict buildings, and infrastructure that serves a single dwelling. Water feeding GWDTEs of low groundwater dependence with no designation or groundwater that supports a wetland not classified as a GWDTE, although may receive some minor contribution from groundwater.	Unproductive strata Peat, Interglacial lacustrine deposits, London Clay. GWTDE such as Marshy Grassland 1 and Wet Woodland 1, and Brockwell Meadows Local Nature Reserve.

Importance	RDWE matter	Description	Examples within the study area
	Flood risk	Water-compatible development[1] (e.g. flood control infrastructure, water/sewage transmission infrastructure and pumping stations, amenity open space, nature conservation and biodiversity, outdoor sports and recreation).	Rivenhall Oaks Golf Centre north-west of Rivenhall End.

[1] Highly vulnerable development, more vulnerable development, less vulnerable development and water-compatible development are defined in the NPPF

14.9 Potential impacts

14.9.1 Potential impacts on the water environment could arise from a number of direct and indirect sources during the construction and operational phases of the proposed scheme. This section summarises these potential impacts.

Construction

14.9.2 Temporary construction impacts on the water environment that would last for all, or part of, the construction phase are discussed in this section. Permanent impacts that could result from the construction of the proposed scheme are discussed within the operation section. Temporary impacts are likely to include the following.

Surface water quality

14.9.3 During construction, there are generally two sources of pollutants to the water environment: sediments and other potentially polluting substances.

14.9.4 There would likely be an increased pollution risk from mobilised sediments in runoff. These could reach watercourses directly via overland flow or the drainage network, to impact water quality. This could occur through a variety of construction-related activities such as: earthworks (i.e. regrading and construction of new embankments and cuttings); vegetation clearance and topsoil stripping; piling; construction of borrow pits (located adjacent to Ordinary Watercourses 7, 15, 21, 21a and 32); the movement of heavy machinery/vehicles; and runoff from stockpiles. There is a high likelihood of silt being generated from construction activities which would be greater after rainfall events.

14.9.5 Groundwater control activities such as dewatering may be required particularly for any cuttings or excavations, including borrow pits. Discharge waters from construction dewatering activities would likely contain suspended solids and may therefore result in contamination of a receiving water body.

14.9.6 During construction, there is a risk of surface water contamination from the accidental spillage of fuels, lubricants, cements, grouts, hydraulic fluids or other harmful substances. These could be stored and used throughout the proposed scheme. Although the main storage areas would be in the construction

compounds, leaks and spills of these materials could migrate from the ground surface into watercourses via runoff or could directly enter watercourses.

14.9.7 The use of cementitious materials, such as concrete, has the potential to contaminate surface waters, including altering its pH (becoming more alkaline). This is most likely to occur if concrete is used within a watercourse, such as for new outfalls or culverts.

14.9.8 Temporary construction drainage would be used to ensure the collection of rainfall runoff from construction areas, compounds and haul roads. This has the potential to be contaminated with pollutants, and should the drainage discharge to a watercourse or groundwater, this would provide a pathway for pollutants. Particular measures are outlined in the REAC, within the first iteration of the EMP [TR010060/APP/6.5] to prevent pollution from haul roads and site compounds located in close proximity to watercourses. These measures will be included in detail in the second iteration of the EMP.

14.9.9 The risks of pollution are greater where works occur within or immediately adjacent to a watercourse, such as during the construction or modification of outfall structures and culverts. There is also a higher risk where works would take place close to existing gullies or drains forming part of the existing highways drainage network, which can be some distance from a watercourse. The drainage network creates a pathway for pollutants to reach the watercourse.

14.9.10 If not disapplied and where required, permits would be required for controlled discharges to surface waters during construction (such as those from dewatering activities) from either the Environment Agency (environmental permit) or LLFA (watercourse consent). Therefore controlled discharges to surface waters have not been considered further as these will be required to comply with the Environment Agency and LLFA independently of the DCO.

Surface water resource

14.9.11 If not disapplied and where required, an abstraction licence from the Environment Agency would be required for surface water abstractions during construction. The location, timing, duration and quantities of water required are not known at this stage. Any licence conditions would be met as a requirement of the licence and so surface water abstractions have not been considered further.

Hydromorphology

14.9.12 Piling adjacent to or on the banks of a watercourse could lead to destabilisation of the bed and banks of the channel. If required, works would be undertaken under and in accordance with environmental permitting requirements to address and mitigate impacts associated with in-channel and bankside works.

14.9.13 Bed and bank scour have the potential to occur locally at the temporary working areas for new or extended culverts, outfall structures and piling on or near to river banks. The inclusion of new or widened bridges, outfalls and drain confluences could also change sediment and/or flow dynamics locally to create areas of localised scour.

14.9.14 There is potential for localised changes to sediment transport dynamics and conveyance following channel realignments, some of which could cause localised extensions and reductions of the channel length.

14.9.15 There is potential for release of fine sediment following excavations of floodplain compensation areas and reconnection of floodplain areas to river channels. The latter would also expose banks to localised scour.

Water Framework Directive Regulations

14.9.16 Impacts would include loss of riparian vegetation following the construction and use of haul roads, and construction of the highway structure along all screened-in WFD Regulations surface water bodies. Where channel realignments tie-in to the existing Domsey Brook and Roman River, there would be a temporary loss of riparian vegetation as the channel is excavated.

14.9.17 There would likely be loss or fragmentation of aquatic species (fish and invertebrates) as a result of in-channel and bankside working as the highway structure is constructed and channel realignments are excavated. This loss could arise from fine sediment, overpumping and vibrations from construction vehicles. Fluming could also act as an obstacle to migratory fish due to the uninviting appearance of the active channel.

14.9.18 All activities associated with the construction of the proposed scheme could lead to the further spread of invasive non-native species. However, through management plans (see first iteration EMP [TR010060/APP/6.5]), such impacts are unlikely to lead to deterioration in water quality element status.

Groundwater

14.9.19 The impacts to groundwater during the construction of the proposed scheme are listed in this section.

14.9.20 Dewatering during construction works is likely to locally lower groundwater levels and promote groundwater flow laterally and vertically towards the works. These can in turn impact on groundwater receptors such as the following:

- Nearby groundwater abstractions, surface water receptors and GWDTEs potentially resulting in loss of supply for a groundwater abstraction user or a reduction of baseflow contribution to a watercourse or loss of recharge for a GWDTE.
- Mobilising groundwater from areas with pre-existing poor groundwater quality towards the work sites. This would apply for example to any areas with known contamination, such as petrol stations, and may pose contamination risk to discharge to nearby surface water.
- Reductions in groundwater levels inducing settlement in cohesive geological units. This would potentially lead to impacts on property, heritage assets and infrastructure.

14.9.21 Discharge of groundwater from dewatering activities is likely to be required to surface water bodies or back to groundwater through groundwater recharge arrangement. This can impact groundwater levels, flow and quality in the vicinity

of recharge area, especially if recharging to a different groundwater body or area than abstracted from.

14.9.22 A gas main diversion is required to facilitate the permanent A12 widening and construction works associated with it. These works may require dewatering, hence could impact nearby groundwater receptors. This is discussed from a groundwater perspective in Section 7 of Appendix 14.4 [TR010060/APP/6.3].

14.9.23 Piling is likely to be required for temporary works, widening of existing bridges and new bridges for retaining walls and for the foundations for cantilevered road gantry signs. Piled foundation depths are expected to be between 10m to 35m bgl based on preliminary design information.

14.9.24 Location of the sheet and concrete piles are presented in Figure 12.3 [TR010060/APP/6.2]. Piling has the potential to create temporary pathways for poor quality perched groundwater to migrate to aquifer units or confined deeper horizons. Piling techniques can also introduce sediments or contaminated soils to an aquifer body as material is pushed down by the piling technique.

14.9.25 Any potential impacts from piling are likely to be limited to shallow groundwater within Secondary aquifers, where present, or shallow groundwater confined to water-bearing units in low productivity strata. No piling would extend into the Principal Chalk aquifer at depth below the London Clay.

14.9.26 The works also have the potential to impact on groundwater quality (and water quality associated with secondary receptors such as GWDTEs and groundwater abstractions) from accidental spillage or releases during construction activities by the following paths:

- There is a risk of accidental spills and releases of fuels, lubricants, cementitious and other harmful substances used or stored during construction particularly at construction compounds and laydown areas. These can impact groundwater by migration through permeable shallow soils, washdown and runoff to permeable areas, leakage of site drainage or preferential migration through boreholes and monitoring wells. Larger releases or spills may migrate within groundwater to nearby groundwater receptors such as surface water, GWDTEs or shallow groundwater abstractions.

- The use of cementitious materials such as wet concrete has the potential to contaminate groundwater, including altering its pH (becoming more alkaline). This is most likely to occur if wet concrete is used below the water table. Wash-out water from wet concrete batching plants also has the potential to impact on groundwater quality if discharged to ground.

14.9.27 There is a risk of physical contamination of groundwater from activities such as soil stripping (including stripping for haul roads and construction compounds), construction of cuttings, attenuation ponds and foundations. This disturbance has the potential for mobilisation of contamination or turbidity impacts on aquifers reaching groundwater-dependent features.

14.9.28 Temporary drainage would be used to ensure the collection of rainfall runoff from construction areas, compounds and haul roads. This has the potential to reduce the amount of rainfall recharging the superficial aquifers. Discharge to

ground from temporary construction drainage may be required. This has the potential to be contaminated with pollutants, and should the drainage discharge to groundwater, this would provide a pathway for pollutants.

14.9.29 Where required, the following detailed assessments of potential impacts are presented in Appendix 14.4 [TR010060/APP/6.3]:

- Detailed dewatering impact assessment (road cuttings/widenings, attenuations ponds and borrow pits): Section 3 of Appendix 14.4
- GWDTE: Section 5 of Appendix 14.4
- Complementary settlement preliminary assessment: Section 4 of Appendix 14.4
- Potential quality impacts on GWDTEs and groundwater abstractions are also included in Section 5 and Section 6 of Appendix 14.4 respectively.

14.9.30 The potential impacts of the gas main diversion works are presented in Section 7 of Appendix 14.4 [TR010060/APP/6.3]. These potential impacts take into account embedded and standard mitigation measures. Where additional mitigation measures are proposed these are presented in the groundwater sub-section of Section 14.10 of this chapter.

Flood risk

14.9.31 Construction works (including stockpiled materials) on fluvial, overland and groundwater flow paths, fluvial floodplain, or any in-channel works could lead to flow being impeded, surface water flow paths altered, or a loss of floodplain volume and a potential increase in flood risk or a disruption of works sites.

14.9.32 Sediment, construction materials and equipment stored in the floodplain or on flow paths could be washed downstream where it could block watercourse channels, land drains and sewers, and increase the risk of flooding.

14.9.33 Construction drainage and dewatering of below-ground construction elements discharging to watercourses or to ground could increase the rate and volume of runoff and increase the risk of blockages in watercourses that could lead to flow being impeded, and potentially increase flood risk.

14.9.34 Construction works could cause an increase in the rate and volume of surface water runoff by increasing impermeable areas or by reducing permeability by compacting soils.

14.9.35 Excavations could potentially damage existing sewers or water supply infrastructure and lead to flooding.

14.9.36 Watercourse channels may have to be temporarily diverted or constricted to facilitate works (e.g. proposed works to existing watercourse crossing structures). Subject to appropriate permits, methods such as temporary overpumping of watercourses or use of sheet piling (or other water-retaining structures) would be employed to manage flows in the channel. This could temporarily reduce the capacity of the channel and increase flood risk.

Operation

14.9.37 Operational and permanent construction impacts of the proposed scheme on the water environment that would be likely without appropriate mitigation, are described below.

Surface water quality

14.9.38 Surface water quality has been assessed using the HEWRAT tool and is summarised in this section with a detailed assessment presented in the WQAR (Appendix 14.1 [TR010060/APP/6.3]).

14.9.39 There are two main types of pollution from roads during the operational phase: road runoff and accidental spillage risk. During routine operation, pollutants such as suspended solids, heavy metals, hydrocarbons, herbicides and de-icing materials can be present in the routine runoff from the road surface. These come from a variety of sources such as the following:

- Fuel and other oil deposits on the road surface due to leakage
- Hydrocarbons from exhaust deposits
- Lead, copper, zinc, iron and cadmium deposits from exhaust emissions, brake dust and tyre wear
- Synthetic rubber deposits from tyre wear
- Herbicides from vegetation management activities
- Chemicals used in windscreen washes such as detergents or de-icer
- De-icing agents such as road salt, but also potentially including trace amounts of impurities such as cyanide, metals and clays.

14.9.40 These pollutants, when combined with rainfall, can run into the highway drainage system which discharges to a watercourse. This can directly or indirectly impact the water quality and the aquatic habitat within a receiving watercourse. The following potential impacts to water quality could occur:

- Suspended solids could smother substrate and increase turbidity with a consequent reduction in light penetration and lowering of oxygenation.
- Heavy metals in soluble form would be more ‘bio-available’ and particularly toxic; some heavy metals would also be sediment-bound.
- Hydrocarbons and herbicides would have direct impacts and are toxic to freshwater organisms.
- De-icing agents could cause high levels of Biological Oxygen Demand (BOD) where de-icing agents other than rock salt are used.

Hydromorphology

14.9.41 Operational impacts associated with the proposed scheme would likely include the following:

- Loss of the bed and banks of the channel as a result of culvert extensions and/or creation.
- Changes to local flow dynamics following adaptations to the road drainage network (i.e. outfall structures), extended culverts, both widened and newly constructed bridges, improved floodplain connectivity and new compensation areas.
- Bed and bank scour localised to new or extended culverts, new or widened bridges, outfalls and drain confluences. This would also be the case for reconnected floodplains, whereby localised bed and bank scour could take place as flooding recedes.
- Localised and temporary changes to flow regime and dynamics as a result of the improved floodplain connectivity and excavated compensation areas. This would also lead to increased fine sediment availability once inundated and could lead to local changes in sediment transport dynamics.
- Localised changes to sediment transport dynamics and conveyance following channel realignments, some of which cause localised extensions and reductions of the channel length.
- Localised sediment aggradation following the construction of flood mitigation bunds which could inhibit floodplain sediment transportation during periods of flooding.

14.9.42 Similar impacts are anticipated on the hydromorphological quality elements of scoped in WFD Regulations surface water bodies. These are detailed further in Appendix 14.2 [TR010060/APP/6.3].

Groundwater

14.9.43 Drainage outfalls to ditches or streams with predicted low flow rates may impact groundwater quality as the discharge is likely to infiltrate to ground. Potential contaminants of concern would primarily consist of dissolved heavy metals and silts.

14.9.44 Spills on the carriageway may occur as the result of a traffic accident. This would have the potential to impact on groundwater if the system was not fully lined. The assessment of risks from routine runoff is presented in the WQAR (Appendix 14.1 [TR010060/APP/6.3]).

14.9.45 The presence of permanent below-ground structures within the shallow aquifer, most notably sheet piles, have the potential to locally alter groundwater levels and flows. This could lead to an impact on nearby groundwater receptors and localised groundwater flooding. A detailed review of potential groundwater flow disruptions resulting from proposed sheet piles is presented in the FRA (Appendix 14.5 [TR010060/APP/6.3]).

14.9.46 Cuttings and widenings, especially related to junctions and underpasses, may require permanent dewatering and drainage during operation to prevent flooding or structural damage to roads and carriageways. The findings of the dewatering assessment presented in Section 3 of Appendix 14.4

[TR010060/APP/6.3], and discussed in the construction phase would therefore remain applicable during operation for road cuttings and widening. This would include impacts on secondary receptors.

14.9.47 The increase in areas of hardstanding has the potential to reduce recharge to the superficial aquifer potentially impacting on groundwater levels and flows.

14.9.48 The long-term impact of embankments could result in local compaction of the superficial aquifer deposits. In addition, it could reduce local recharge where the ground would be covered. This could result in a decrease in groundwater quantity available to secondary receptors. This is discussed in more detail in the FRA (Appendix 14.5 [TR010060/APP/6.3]).

14.9.49 Flood storage areas which are permeable could act as areas of enhanced groundwater recharge potentially increasing groundwater levels locally. Further information is presented in the FRA (Appendix 14.5).

Flood risk

14.9.50 There would be an increased risk of fluvial flooding as a result of loss of floodplain storage or in-channel structures restricting watercourse flow.

14.9.51 There would be an increased risk of flooding (fluvial, surface water, sewer and drainage infrastructure) due to increases in the rate and volume of runoff caused by an increase in impermeable surfaces.

14.9.52 Where proposed scheme elements coincide with areas of existing groundwater flood risk, these may lead to an increased risk of groundwater flooding and a loss of flood attenuation. Where subsurface activities are in an area of significant groundwater presence, risk of groundwater flooding may be increased. This is discussed in further detail in the FRA (Appendix 14.5 [TR010060/APP/6.3]).

14.9.53 Where culverts are part of the proposed scheme, these could become blocked and result in an increased risk of fluvial flooding.

14.9.54 Potential risks associated with groundwater flooding are summarised in the groundwater section above and further detailed in the FRA (Appendix 14.5).

14.10 Design, mitigation and enhancement measures

Embedded (design) mitigation

14.10.1 The environment team has worked in close collaboration with the infrastructure design team to avoid or reduce environmental impacts through the scheme design. This is referred to as embedded (or design) mitigation. Chapter 3: Assessment of alternatives [TR010060/APP/6.1], details the design alternatives that have been considered, including the environmental factors which have influenced the decision making.

Drainage design and treatment trains

14.10.2 HEWRAT assessments of each iteration have been undertaken with the results informing the need and extent of further mitigation. This has then been incorporated into subsequent design iterations. The mitigation presented in this

Environmental Statement builds upon the design and HEWRAT results from the design iteration presented in the PEIR (Highways England, 2021b).

14.10.3 The Surface Water Drainage Strategy (Appendix 14.6 [TR010060/APP/6.3]) and the WQAR (Appendix 14.1 [TR010060/APP/6.3]) set out the treatment train specifications for drainage catchments within the extent of the proposed scheme.

14.10.4 The proposed scheme would consist of 92 separate road drainage catchments for road runoff. The A12 mainline would be drained via concrete surface water channels and combined filter drains. Junctions, slip roads, roundabouts and laybys would be drained by a kerb and gully arrangement. Attenuation storage would be provided in the form of attenuation ponds, underground geocellular attenuation storages, swales, vegetated drainage ditches and oversized pipes depending on the site constraints.

14.10.5 Where required, discharge rates during operation would be restricted to achieve the allowable discharge rates and ensure no increase in flood risk. The associated attenuation storage would be sized for 1% (1 in 100) AEP storm event including an allowance for climate change as described in the Surface Water Drainage Strategy (Appendix 14.6 [TR010060/APP/6.3]).

14.10.6 Where ponds have been included for attenuation storage, in general, the maximum depth of the proposed attenuation ponds has been limited to 1.20m (comprising 0.9m peak water depth plus 0.3m freeboard). However, there may be a need to depart from this criterion due to site-specific constraints such as the topography, reducing the excavation depth, and earthworks balancing between cut and fill. An additional permanent water depth of 0.3m is to be designed at the bottom of the attenuation ponds (i.e. below the proposed attenuation pond outlet pipe invert level) to create a permanently wet pond. This would provide water quality treatment and biodiversity benefits.

14.10.7 Sediment forebays are to be provided at the inlet of all proposed attenuation ponds which would provide effective pre-treatment (i.e. removal of coarse sediments) and ensure ease of maintenance during the removal of any such collected coarse sediments. The main storage compartment is located after the sediment forebay and would have a permanent water pool which would act as the main surface water treatment zone. Where required, the proposed attenuation ponds can also be cascaded (i.e. contain multiple storage compartments) to increase the residence time and enable the additional sedimentation of particulate matter to occur. In addition, proposed attenuation ponds would be planted with vegetation sufficiently robust to withstand the potential pollutants suspended in the surface water runoff which would provide additional water quality treatment benefits. Perennial ryegrass and fescues are typical for this purpose (SuDS Manual C753, (CIRIA, 2015a)).

14.10.8 The vegetation in swales or vegetated ditches would slow the surface water flow rate provided the flow is at or below the level of the vegetation. This would increase water residence time in the swale and force sediments and other potential pollutants to settle out. Check dams can also be provided to maximise the level of treatment. Check dam provision would be assessed at the detailed design stage. Where practicable, swales or vegetated ditches are provided from

some proposed attenuation ponds as an added level of treatment prior to the surface water discharging to the receiving watercourse.

14.10.9 Filter drains would filter out some fine sediments, metals, hydrocarbons and other pollutants as the surface water runoff percolates down through the trench fill material overlying the perforated filter drain.

14.10.10 Silt traps in chambers and gullies would provide suspended particulate matter retention with regular maintenance.

14.10.11 The treatment efficiencies of the SuDS which have been used in the assessments are taken from DMRB CG 501 (Highways England, 2020e). Details of the drainage design and SuDS are presented in the Surface Water Drainage Strategy (Appendix 14.6 [TR010060/APP/6.3]). Details of the treatment trains for each drainage catchment and the treatment efficiencies used in the HEWRAT assessments are presented in Table 2 and Table 3 of Appendix 14.1 [TR010060/APP/6.3].

14.10.12 The WQAR presented in Appendix 14.1 of the Environmental Statement includes an assessment of spillage risk. This assessment has concluded that the risk of a serious chemical spillage from all road catchments is low and within the standards set out in DMRB LA 113 (Highways England, 2020a). Isolation chambers fitted with penstock valves would be located immediately downstream of proposed attenuation storage device locations, at the downstream end of the proposed highway drainage systems. This would allow isolation of the pollutants within the highway drainage system thereby avoiding pollution to receiving watercourses.

14.10.13 Pollution from maintenance activities during the operational phase, such as the use of herbicides and de-icing salts as a result of responsive activities, are difficult to predict and design for. It can however be controlled through good operational management regimes by the road operator. The prevention of ice formation and the de-icing of highways within the UK is carried out almost exclusively using rock salt complying with BS 3247:2011 Specification for salt for spreading on highways for winter maintenance (+A1:2016). Road salt is applied typically in the winter months and therefore only spread on the highway on a small number of days per year. In the Memorandum of Understanding (MoU) between National Highways (formerly Highways Agency) and the Environment Agency (Highways Agency and Environment Agency, 2009) Annex 1 Water Environment, the following are agreed:

- Prior to the use of de-icing agents other than rock salt, National Highways should consult with the Environment Agency.
- The Environment Agency does not require National Highways to apply for consent for normal routine maintenance operations, including the application of de-icing agents. However, both parties are aware that the application of de-icing agents can have impacts on water quality in receiving watercourses, particularly high levels of BOD and hence the parties are committed to investigating alternatives to conventional products currently in use.

Pond loss

14.10.14 Where existing ponds would be lost as a result of the proposed scheme, landscaping proposals make provision for the creation of a total of 57 new wildlife ponds (in additional to the 71 new attenuation ponds). Therefore, there would be at least seven ponds gained for each lost, excluding attenuation ponds, as detailed in Chapter 9: Biodiversity, of the Environmental Statement [TR010060/APP/6.1]. The new ponds would be designed to mimic natural water bodies and include specific habitats where required.

14.10.15 Out of the 11 ponds within the Order Limits, eight would be lost completely: P43, P63, P64, P68, P69, P70, P87 and P354 and two would have partial impacts (P34, which may be impacted due to realignment of ditches; and P39, approximately 25% of which may be lost to facilitate construction of a ditch).

14.10.16 Further information relating to the mitigation of pond loss is available in Chapter 9: Biodiversity [TR010060/APP/6.1].

Hydromorphology

14.10.17 The Rivenhall Brook culvert has been moved further west to be approximately 90m from the existing A12, which would allow for a more appropriate tie-in location with Rivenhall Brook. Domsey East culvert has also been moved to approximately 100m from the existing A12.

Groundwater

14.10.18 Table 14.11 identifies embedded mitigation of relevance to groundwater.

Table 14.11 Embedded mitigation measures of relevance to groundwater

Groundwater embedded mitigation measures	Description
Long-term drainage of cuttings	To protect flood-sensitive receptors (including the new road) from groundwater flooding during the operational phase, groundwater seepage would be collected by the proposed road drainage system.
Long-term drainage for infrastructure at grade	To protect infrastructure at grade from groundwater flooding during the operational phase, drainage systems would be installed where there are shallow, pre-existing groundwater conditions. These would collect excess groundwater to prevent groundwater reaching the surface.
Long-term drainage for embankments and retaining walls	To prevent flooding at the surface around embankment and retaining wall areas where pre-existing groundwater conditions are known to be shallow, drainage systems would be installed up-gradient of the embankment to limit the build-up of water.

Groundwater embedded mitigation measures	Description
Foundation design to permit groundwater flow	All foundations at or below structures expected to intercept high groundwater levels and which could form a barrier to groundwater flow would be designed to allow existing groundwater flow paths to function. This would prevent an increase in groundwater flood risk and would protect flood-sensitive receptors elsewhere. This will be achieved during the detailed design stage and using complementary ground investigation results.
Embankment design to permit groundwater flow	Ground compaction as a result of any embankments would be expected to restrict groundwater flow in the areas that coincide with shallow groundwater levels. In these instances, embankments would be designed to allow existing groundwater flow paths to function. This would prevent an increase in groundwater flood risk to flood-sensitive receptors elsewhere.
Flood mitigation and floodplain compensation areas	Flood mitigation and floodplain compensation areas would be designed taking groundwater levels into account. This means that as part of the detailed design phase, where groundwater is expected to be shallower than the bottom of the flood mitigation area, the design is adjusted to account for groundwater. However, it is likely that groundwater flows would drain from the mitigation areas at a faster rate than inflow from groundwater and therefore impact is anticipated to be minimal.
Groundwater Protection	The drainage development during the detailed design phase would continue to be aligned with the Environment Agency guidance, Protect Groundwater and Prevent Groundwater Pollution (Environment Agency, 2017).

Flood risk

14.10.19 Flood risk has been a consideration throughout the evolution of the proposed scheme design (see Chapter 3: Assessment of alternatives [TR010060/APP/6.1]). The alignment has been refined to reduce encroachment into the River Blackwater flood zone.

14.10.20 The decision was taken to retain the existing River Ter Bridge structure, as opposed to widening this structure or replacing with a new wider structure. Retaining the existing River Ter Bridge reduced the flood risk impacts of the proposed scheme on the River Ter floodplain.

14.10.21 Previous iterations of the proposed scheme involved extending the existing Boreham Brook A12 culvert to the south. With flood risk implications as a consideration, the updated proposed scheme design was changed so that there would be no alteration or extension to the existing Boreham Brook A12 culvert.

14.10.22 Flood risk has been a significant consideration throughout the design of the realignment of the walking, cycling and horse-riding (WCH) route and footbridge to the south of Ashman's Bridge (crossing the River Blackwater and associated floodplain).

Standard mitigation

14.10.23 Standard mitigation would occur as a matter of course due to legislative requirements or standard sector practices. Examples of standard mitigation for this aspect are discussed here.

Construction

14.10.24 Standard mitigation is included in the REAC, within the first iteration EMP [TR010060/APP/6.5] which forms part of the DCO submission (refer to Chapter 5: Environmental assessment methodology [TR010060/APP/6.1]). The EMP includes measures that would be undertaken during construction to mitigate temporary effects on the water environment. The EMP includes a range of measures, which accord with legal compliance and good practice guidance when working within or around sensitive water resources. These measures would include the following where appropriate and practicable:

- Measures to control the storage, handling, spillages and disposal of potentially polluting substances during construction. Where required, these would be undertaken in accordance with legislation and best practice guidance as detailed in the first iteration of the EMP [TR010060/APP/6.5].
- Where practicable, site layout would ensure material stockpiles and storage areas would not be located less than 10m from adjacent watercourses, ponds, boreholes and site drainage, and not within Flood Zone 3 and overland flow paths. Where this cannot be achieved, stockpiles would be limited such that they can be moved upon receipt of any flood warning/adverse weather conditions, or on-site additional mitigation measures (such as bunds) would be implemented to provide an adequate barrier between the potential source of contaminated runoff and the receptor.
- Fuel, oil and chemicals that have the potential to cause significant damage to the environment would be stored in a safe and secure bund or other container from which they cannot leak, spill or be open to vandalism.
- Where practicable, permanent works attenuation ponds would be constructed early in the programme. It is proposed to make use of the permanent works attenuation ponds for settlement of construction discharge water; however, some additional temporary attenuation ponds may be required in certain areas. The management and use of the ponds would be in accordance with the Water Management Plan, within the first iteration of the EMP [TR010060/APP/6.5]. Where the permanent attenuation ponds are used during construction for drainage and treatment, any sediment accumulated would be removed prior to the end of the construction period so as to maintain the capacity of the ponds for attenuation and water quality treatment purposes during operation.
- Water would be pumped into attenuation ponds when required and water bowsers would use them as a water source when dust suppression is required. The management requirements of the use of water from these ponds would be detailed in the second iteration EMP. If determined to be

appropriate by the Environment Agency or Essex County Council, as the LLFA, alternative supplies would be considered such as connection to mains supplies.

- Activities within areas at risk of flooding would be managed (i.e. kept to a minimum) with temporary land take required for construction located outside the floodplain as far as reasonably practicable, or allowances made for floodplain control measures and contingency actions.
- Where necessary, implementation of temporary mitigation measures would prevent an increase in flood risk as a result of flood waters displaced during temporary construction works (for example due to raised storage areas, haul roads and cabins).
- Construction work would be phased such that any required flood mitigation areas would be constructed prior to any encroachment into the floodplain caused by the proposed scheme to ensure no overall adverse impact.
- Managing the risk from groundwater flooding (during excavation) through appropriate working practices and with adequate plans and equipment in place for dewatering would ensure safe and dry working environments. Specific discharge locations for flows from dewatering activities have not yet been established, generally discharge of such flows would be to the closest drainage ditch/watercourse. Where dewatering to watercourses is proposed, discharge rates would be carefully controlled to achieve no environmentally significant change to flood risk associated with the receiving watercourses as a result of dewatering discharges. If required, dewatering discharge would be temporarily paused during flood events to prevent any increased flood risk during the flood event. The FRA contains an assessment of anticipated dewatering flows.
- Where groundwater control is required, isolation techniques would be considered in preference to dewatering, if feasible, to limit impacts to stream baseflow and subsequently downstream designated sites. Specific discharge locations for flows from dewatering activities have not yet been established. Generally, discharge of such flows would be to the closest drainage ditch/watercourse.
- All discharge peak flows would be carefully controlled (as discharging water at high velocities into a watercourse can cause disturbance and erosion of the banks or bed) in accordance with the requirements of the permitting authority. The exit velocity at the outfall(s) would be reduced, where required, using baffles or similar systems, and the outfall(s) aligned downstream by 45°, ensuring they would not protrude into the channel. The same precautions would be taken when overpumping water along a watercourse.
- Discharge of water from dewatering (such as from borrow pit dewatering) may require an Environmental Permit or discharge licence from the Environment Agency, which would be subject to conditions including specific water quality requirements. Typically, any dewatering over 20m^3/d would

also be subject to an abstraction licence issued by the Environment Agency. For surface water quality, water would be discharged following settlement to remove suspended solids. To achieve this, temporary storage basins may be required, or the attenuation ponds constructed for the proposed scheme would be used temporarily as described above. Further investigations and impact assessments will be required as part of the licensing process to confirm rates of abstraction and area of influence and identify potential receptors within the area of influence.

- Discharge of water from dewatering (such as from borrow pit dewatering) may be to groundwater through groundwater recharge arrangements to manage groundwater levels. The suitability of this method will be investigated through detailed design of the proposed scheme and further investigations and impact assessments will be required as part of the permitting process with the Environment Agency to confirm rates of abstraction, discharge, flood risk, areas of influence and identify potential receptors within the area of influence.
- Temporary site drainage (incorporating SuDS measures) would be planned to manage the risks associated with heavy rainfall or flood events appropriate to the risk during construction such as the topography, catchment size and duration of the works. Where temporary drainage is required, it would be sized to provide an appropriate standard of flood protection, with a 10% (1 in 10) AEP event standard. This would be identified within the Water Management Plan prior to commencement of applicable works in that catchment, for example earthworks.
- Working practices would be aligned with the Environment Agency guidance, Protect Groundwater and Prevent Groundwater Pollution (Environment Agency, 2017).
- The Environment Agency's Flood Warning Service would be adopted by the Principal Contractor during construction and a suitable flood risk action plan developed. This would plan for the effective and safe evacuation of personnel (and plant, if safe to do so) from areas at risk on receipt of a flood warning. Areas of the Chelmer, Brain and Blackwater Rivers are within Environment Agency flood warning areas.
- Where overpumping of watercourses would be used during construction (e.g. to enable works within watercourse channels), overpumping pipes would be sized appropriately for the watercourse flows in consultation with regulators.
- Where water-retaining structures would be used during construction to restrict flows in watercourse cannels (e.g. to enable works within watercourse channels), the structures would be designed so that they would be overtopped by the 5% (1 in 20) AEP event. Therefore, the retaining structures would have minimal impact on channel capacity during a more extreme flood event.

- Where watercourse crossings would be required during construction, a 10% (1 in 10) AEP event standard is proposed to be used to size these crossing structures. As part of the relevant Flood Risk Activity Permit or watercourse consent application, the flood event appropriate for each watercourse would be consulted with the Environment Agency (for Main Rivers) or the Local Flooding Authority (for Ordinary Watercourses), respectively. This would ensure a low risk of the works causing an increase in flooding to receptors, particularly as the risk of an event occurring during the short construction timescales would be low.
- Extent of the vegetation clearance along the riparian corridor would be carried out where required to enable the construction of the proposed scheme. Vegetation clearance would be carried out under supervision of an Ecological Clerk of Works or appropriate supervision.
- Temporary culverts (if required) carrying haul roads or other temporary works across watercourses would be as short as is practicable and tied into the beds and banks to prevent bank instability. This would involve submerging the invert below the bed substrate to prevent bed scour, knickpoint formation and to maintain sediment conveyance. In addition, wingwalls would be aligned with the banks to prevent fluvial processes from outflanking the culvert.
- Channels would be reinstated appropriately following the deconstruction of temporary structures in the channel or channel banks (i.e. culverts and outfalls). This would prevent knickpoint formation or additional channel instabilities from occurring. If required, works would be undertaken in accordance with an environmental permit or licence for in-channel/bankside working that would include mitigation to address impacts.
- Construction of haul roads and temporary watercourse crossings would be designed to reduce risk of erosion. Where this is not practicable, bed and bank reinforcement would be placed along areas that are at risk of or have evidence of erosion during the construction of haul roads and temporary watercourse crossings. This would help mitigate construction impacts and aim to reduce the likelihood of increased bed and bank erosion. The type of bed and bank protection would be determined during the detailed design stage.
- Construction of culverts and realignments would be timed during low flow conditions where practicable, to reduce the impact on flow dynamics and sediment transport.
- Construction of drains behind the riverbank would be carried out in advance of the connection to the receiving watercourse.
- Where borrow pits are excavated, a 10m buffer would be implemented, where practicable, around any ponds or watercourses present within or adjacent to the where excavations are to take place. This would mitigate any potential impacts arising from silt-laden runoff. If required, works would be

undertaken in accordance with an environmental permit or licence for in-channel/bankside working that would include mitigation to address impacts.

- The Water Management Plan, within the first iteration of the EMP [TR010060/APP/6.5], details measures to reduce the pollution and flood risk from haul roads, laydown areas and site compounds, so that surface water runoff does not freely flow into neighbouring watercourses.
- Detailed site-specific dewatering assessments would be developed for cuttings, widenings and borrow pits as required to inform the detailed design, temporary works and subsequent permit applications.
- Storage of excavated soils and made ground would be managed in such a way that soil storage periods are minimised in duration and all storage areas would be managed in accordance with the Soil Handling Management Plan, part of the first iteration EMP [TR010060/APP/6.5], to ensure that no polluted water percolates into the ground and no contaminated runoff is generated.
- Where contaminant land or groundwater issues have been identified, a piling risk assessment is required prior to the relevant piling being undertaken to ensure that the proposed piling method would not have any adverse impact by creating new pathways for the migration of potential contamination, primarily in relation to the protection of water resources.
- Typically, any temporary works would be designed so as not to create temporary build-up of groundwater levels leading to groundwater flooding. Where required, temporary works would be designed so that they could be removed. Any temporary supports such as sheet piles that cannot be removed would be left in situ. These would be assessed to ensure that they do not lead to the long-term build-up of groundwater leading to potential flooding risks or risks to groundwater receptors such as GWDTEs by restricting long term groundwater flow.
- Any contaminated groundwater intercepted during construction which cannot be treated to achieve consented discharge parameters would be tanked and disposed of off-site at an appropriate licensed location.
- Where practicable, precast concrete structures would be used to minimise the impact of wet cementitious materials on groundwater and surface water quality.
- There would be concrete batching plants located at the main project compounds. Any work involving wet concrete and cement carried out over, under or near a watercourse would be carried out in accordance with the agreed consent from the relevant authority. Designated areas would be set out for the purpose of concrete wash-out (i.e. for concrete mixer and associated chute, tools or equipment). Requirements are detailed in the first iteration of the EMP [TR010060/APP/6.5].

- Where water is to be discharged to watercourses, constraints on the discharge rate, pre-treatment and the scope of the quality and level monitoring required would be agreed in advance with the Environment Agency or the LLFA as the appropriate consenting authorities. It is expected that baseline monitoring would be required by consenting authorities for a period in advance of the works which would be agreed with the authorities in advance and detailed in the second iteration EMP.

- Technical information to support applications will be provided to the Environment Agency for a Water Abstraction Licence under the Water Resources Act 1991 and a Water Activity Environmental Permit under the Environmental Permitting (England and Wales) Regulations 2016 or to the LLFA under the Flood and Water Management Act 2010, (where it is not agreed to disapply these regulatory processes through the DCO).

14.10.25 As detailed in Chapter 2: The proposed scheme, of the Environmental Statement [TR010060/APP/6.1], there would be two main compounds and a number of satellite compounds and laydown areas during construction. To prevent deterioration of water quality in receiving watercourses from the construction compounds, construction compounds would typically include:

- A water management area to manage site runoff from the impermeable area

- Where feasible, rainwater would drain through the granular type construction of the hardstanding on each compound, with surface water from the cabins routed to suitable soakaways where practicable.

- Foul drainage from the cabin and welfare units at each compound would either be collected in storage tanks which would be emptied regularly by a tanker (with appropriate waste carrier licence etc.) for offsite disposal at a suitably licensed waste-water facility, or connection to the main sewerage would be sought from the sewerage undertaker; or foul drainage would be discharged to a watercourse following suitable treatment.

14.10.26 CIRIA guidance would be adopted as standard mitigation as appropriate including from the following publications:

- Environmental Handbook for Building and Civil Engineering Projects (3 Parts: C512, C528 and C529) (CIRIA, 2000a-c)

- Control of water pollution from construction sites. Guidance for consultants and contractors (C532) (CIRIA, 2001)

- Control of water pollution from linear construction projects. Technical guidance (C648) (CIRIA, 2006a) and site guide (C649) (CIRIA, 2006b)

- Groundwater control: design and practice, second edition (C750) (CIRIA, 2016)

- Environmental good practice on site guide (fourth edition) (C741) (CIRIA, 2015b)

Operation

Surface water

14.10.27 The current drainage design criteria are outlined in the FRA (Appendix 14.5 [TR010060/APP/6.3] and the Surface Water Drainage Strategy (Appendix 14.6 [TR010060/APP/6.3]).

14.10.28 Maintenance and management of the drainage network and assets would be required as part of the operation of the proposed scheme as per standard National Highways guidance and practice as outlined in the SuDS Manual C753 (CIRIA, 2015a). Further details are presented in the Surface Water Drainage Strategy (Appendix 14.6).

Hydromorphology

14.10.29 Where reasonably practicable, standard operational hydromorphological mitigation regarding the design of drainage outfalls would comply with CIRIA guidance (Culvert, screen and outfall manual (C786) (CIRIA, 2019)) and would consider the SEPA Good Practice Guide: Intakes and Outfalls (SEPA, 2019).

14.10.30 New outfalls to watercourses would be set back from the riverbank.

Watercourse realignments

14.10.31 The proposed scheme would require realignment of a number of watercourses:

- Rivenhall Brook (Main River)
- Domsey Brook (Main River) (three realignments)
- Roman River (Main River)

14.10.32 Various measures would be implemented, where practicable, to mitigate potential impacts on the water environment, including the following:

- Excavation of a two-stage channel along the Main River realignments and, where practicable, Ordinary Watercourses.
- For Roman River, the lack of space means a two-stage channel cannot be excavated. Instead, a one-stage channel would comprise varied bottom widths to promote berm creation and habitat variability.
- Where practicable, the existing length and gradient of the watercourse would be retained.
- Where practicable, natural processes and flow variation would be encouraged by excavating a gently sinuous planform.
- For the realignments the bed material would replicate that of the existing watercourse which is to be realigned. Thus, bed material from the existing channel would be transferred to the realigned channel. The source of the material would be the channel that would be inactive following realignment.
- Decomposable geotextile bank protection would be installed along the upper banks to encourage vegetation establishment and channel stabilisation.

- Watercourse realignments would be designed such that they would not increase flood risk. If local constraints mean this cannot be achieved, additional mitigation would be provided to ensure no increase in flood risk elsewhere. Further details are provided in the FRA (Appendix 14.5 [TR010060/APP/6.3]).

Watercourse crossings (bridges and culverts)

14.10.33 Flood risk would be considered in the design of watercourse crossings (e.g. sizing of new culverts) as far as reasonably practicable to reduce the impact these would have on flood risk. The drainage design criteria (included in the Surface Water Drainage Strategy – Appendix 14.6 [TR010060/APP/6.3]) include a requirement for proposed new culverts and extensions of existing culverts would be designed such that they would not result in an increase in flooding (for up to the 1% (1 in 100) AEP event plus allowance for climate change). Where this cannot be achieved due to local constraints, additional mitigation would be provided to ensure no significant effect on flood risk.

14.10.34 Culverts have the potential to become blocked with debris, resulting in increased risk of fluvial flooding. An assessment of blockage risk would be undertaken on all existing and new culverts in accordance with the guidance in the Blockage Management Guide, Environment Agency 2021a). Trash screens would be incorporated into the permanent design where this assessment identifies that they would be required.

14.10.35 Standard hydromorphological mitigation would comply with good practice. Where practicable, these would include the following:

- Culverts:
  - The diameters of new culverts to match that of the natural channel.
  - Limit the length of newly constructed culverts and extensions to prevent loss of the natural bed and banks.
  - Bury the invert beneath the natural bed of watercourses to allow the continuation of sediment conveyance and reduce the impact on local flow dynamics.
  - Tie-in new and extended culverts with the bank to prevent the outflanking of the culvert by fluvial processes.
  - Where the outlets or inlets tie-in with channel or realignment, these tie-in points to involve realigning the channel to a gentle bend rather than perpendicular bend.
- Bridges:
  - Bed and bank reinforcement to only be considered if potential erosion due to new or extended structures cannot be prevented.
  - If piers are required for the new or existing bridges, they would be designed to allow the passage of large woody debris.

Additional mitigation

Surface water quality

14.10.36 The results of the surface water quality assessment indicate that impacts would be no greater than slight adverse and therefore not environmentally significant. As such, no additional mitigation is required for surface water quality. The results are presented in the WQAR (Appendix 14.1 [TR010060/APP/6.3]).

Hydromorphology

14.10.37 The proposed culvert along Ordinary Watercourse 11 could lead to significant effects along the channel. Therefore, monitoring would take place to determine whether bank protection is required to mitigate any further lateral adjustment along the watercourse.

14.10.38 Changes to the alignment of the culvert crossing at Ordinary Watercourse 11 were considered, in an attempt to shorten the culverted channel. However, this would require realignment of Ordinary Watercourse 11 to tie-in the realignment appropriately to the alternative culvert alignment. This option would encroach on the neighbouring quarry (Colemans Farm Quarry) and was therefore considered inappropriate.

14.10.39 Permanent drainage outfalls are located on the channel bends of the following watercourses assessed as exhibiting medium hydromorphological importance:

- River Chelmer
- River Blackwater
- Boreham Brook
- River Ter
- Domsey Brook
- Roman River

14.10.40 To mitigate additional scour and channel instability, monitoring would be carried out to determine whether bank protection is required (see Section 14.12 of this chapter for further details).

14.10.41 The realignment of Rivenhall Brook would reduce the length of the channel and potentially lead to changes in flow regime, dynamics and sediment transport dynamics. To mitigate this, sediment augmentation would take place in the form of a pool-riffle sequence. This would act as almost-natural flow regulation and work to reduce any adverse effects along the channel. During detailed design, advice on the frequency of riffles, grain size and the associated channel cross-sections and long-profile gradient would be provided by a hydromorphologist.

Groundwater

14.10.42 Additional supplementary ground investigation information would be used to support detailed design and assessments associated with dewatering, settlement, drainage, gas main diversion, sheet piles and flood compensation

storage areas, and to support environmental permitting requirements. That would include targeted *in situ* permeability/pump testing, groundwater level and quality monitoring.

14.10.43 Appendix 14.4 [TR010060/APP/6.3] has identified the need to mitigate four licensed groundwater abstractions (LGA-5, LGA-6, LGA-7 and LGA-17) against potential dewatering impacts, with LGA-5 and LGA-6 targeting specifically the gas main diversion works.

14.10.44 Appendix 14.4 [TR010060/APP/6.3] has identified the need to mitigate seven licensed groundwater abstractions (LGA-2, LGA-3, LGA-5, LGA-17, LGA-24, LGA-27 and LGA-33) and two private unlicensed abstractions (PGA-2 and PGA-5) against potential water quality impacts.

14.10.45 From the groundwater abstractions identified as being potentially at risk, only LGA-7, LGA-17, LGA-24, LGA-27 and LGA-33 were recorded as licensed abstractions in the 2016 Envirocheck report (Landmark Information Group, 2016). The Environment Agency would therefore be consulted during detailed design to confirm whether these licences are still active, and if so, request that all the details be provided. If these abstractions are no longer licensed, the landowner would be consulted to determine if they remain active.

14.10.46 For all active abstractions (licensed or unlicensed), the following mitigation measures would be implemented during detailed design:

- Further information would be gathered on groundwater abstractions (including nature, depth and confirmed location of the abstraction) and the impact assessment would be updated to confirm whether additional measures would be implemented.
- Should the revised assessment confirm that additional measures are required, monitoring of the groundwater abstractions prior to and during construction would take place and potentially be extended for a short period post construction.
- Should monitoring indicate an impact during the proposed work, a temporary replacement water supply would be provided, where practicable. If monitoring demonstrates a long-term impact, an alternative solution would be proposed.

14.10.47 In addition to the identified groundwater abstractions at risk, uncertainty remains on the exact location of other groundwater abstractions which have been assessed as not being at significant risk (Sections 3 and 6 of Appendix 14.4 [TR010060/APP/6.3]). Should the abstraction be located nearer than suggested by the coordinates provided by the Environment Agency or local authorities, then the risk profile of these groundwater supplies could increase. For this reason, further information on the source (including nature, depth and confirmed location of the abstraction) would be gathered during detailed design on the following groundwater abstractions: PGA-1, PGA-3, PGA-7, PGA-8, PGA-13, LGA-10 and LGA-26. Once the details are confirmed, should any of these groundwater abstractions be located nearer to the works than assessed initially, the assessment would be revisited and mitigation measures would be proposed

as required. These would follow the same principles as outlined for groundwater abstractions at risk.

14.10.48 Section 4 of Appendix 14.4 [TR010060/APP/6.3] identified that a number of buildings could be at risk of potential differential settlement, based on a preliminary conservative assessment. For those receptors, a detailed differential settlement risk assessment based on the detailed design and supplementary ground investigation would be undertaken. As part of this exercise, should the presence of thick Alluvium be encountered, a detailed settlement risk assessment would also be undertaken at these locations (please also refer to Chapter 7: Cultural heritage, of the Environmental Statement [TR010060/APP/6.1]).

14.10.49 Should detailed assessment confirm that buildings are at risk of differential settlement, additional mitigation measures would be undertaken such as condition surveys and asset protection measures prior to the relevant works being undertaken, and subject to landowner consent, to mitigate any adverse impacts from differential settlement associated with the dewatering activities.

14.10.50 Following a refined characterisation of groundwater quality at road cuttings and widenings expected to intercept groundwater, the detailed groundwater quality assessment would be updated as part of the surface water drainage detailed design. This would determine whether intercepted groundwater at individual cuttings, widening or other structures can be mixed with road runoff, or whether it should be kept separate through separate drainage systems.

14.10.51 No additional mitigation measures are required to protect surface water receptors from dewatering effects.

14.10.52 Section 5 of Appendix 14.4 [TR010060/APP/6.3] has indicated that Wet Woodland 7 could be impacted during the construction of borrow pit I. To mitigate this, more details will be gathered on the functioning of Wet Woodland 7. Groundwater level monitoring using dataloggers would continue at boreholes BH2058, 59 and 60 within Wet Woodland 7, and beside borrow pit I and the A12. This would be complemented by an NVC survey to refine baseline habitat at Wet Woodland 7 and surface water monitoring to provide an understanding of the proportion of surface water which supports Wet Woodland 7 prior to excavation of borrow pit I. Additional ground investigation would include pumping tests at borrow pit I to support a more detailed dewatering impact assessment. BH2058, 59 and 60 would continue to be monitored during the pumping tests and during construction if necessary.

14.10.53 A Water Balance Compensation strategy would be put in place to compensate the loss of natural groundwater recharge to Wet Woodland 7 by diverting extracted groundwater from borrow pit I towards Wet Woodland 7. The volume of water to be diverted would be based on the detailed design and dewatering impact assessment and long-term groundwater monitoring around Wet Woodland 7. The Water Balance Compensation strategy would determine whether monitoring of boreholes BH2058, 59 and 60 would continue during construction of borrow pit I and up until groundwater has rebounded. A post-construction NVC survey would be undertaken by the Principal Contractor to verify that no significant change in vegetation has taken place during construction at Wet Woodland 7.

Flood risk

14.10.54 There are six locations at which additional mitigation is proposed to address significant fluvial flood risk issues (see Figure 14.4 [TR010060/APP/6.2]). These are summarised in Table 14.12, and further detail is included in the FRA (Appendix 14.5 [TR010060/APP/6.3]).

Table 14.12 Locations at which additional mitigation is proposed to address potentially significant flood risk issues

Flood source	Significant flood risk issue identified	Overview of proposed flood mitigation works
Rivenhall Brook	Without any mitigation, the proposed scheme would cause an increase in flood risk to agricultural land downstream of the new A12 crossing of the watercourse (south-west of the new A12 crossing).	Flood mitigation bund along right bank of the watercourse immediately downstream of the new A12 crossing.
Ordinary Watercourse 21	Without any mitigation, the proposed scheme would be at risk of flooding.	Flood storage area upstream of the proposed A12 and diversion pipe/ditch to convey diverted flows west to the River Blackwater.
Ordinary Watercourse 21a	Without any mitigation, the proposed scheme would be at risk of flooding.	Flood mitigation channel to capture flows upstream of the proposed A12.
Several Ordinary Watercourses in the vicinity of Inworth Road	Without any mitigation, areas of proposed scheme works to Inworth Road are at risk of flooding from watercourses in the vicinity.	Flood storage areas to mitigate flood risk to the road.
Ordinary Watercourse 23	Without any mitigation, the proposed scheme would be at risk of flooding.	Ditches to capture flows upstream of the proposed A12, one flood mitigation bund, and excavated flood storage area.
Ordinary Watercourse 26	Without any mitigation, the proposed scheme would be at risk of flooding.	Flood storage area (floodplain compensation) upstream of the proposed A12.

Enhancement

14.10.55 The enhancement measures set out in this section have not been considered when assessing the potential effects of the scheme.

Surface water quality

14.10.56 Surface water quality may be improved by using attenuation ponds to treat road runoff where HEWRAT assessments already indicate discharges comply with legal requirements and DMRB standards without such features in place.

14.10.57 Mitigation for spillage risk is not deemed to be required; however, the attenuation ponds may provide additional containment facilities where none currently exist, leading to an enhancement.

14.10.58 The proposed drainage design includes a number of new features that would offer treatment and therefore an improvement in surface water quality, enhancing the existing situation.

Hydromorphology

14.10.59 The Roman River culvert and Domsey Brook Bridge are long crossings which have historically proved to be an issue for both sediment conveyance and fish passage. Therefore, baffles would be installed to the existing and new portions to provide improved flow dynamics. This would facilitate sediment passage and deposition and encourage fish to pass through the crossing.

14.10.60 The alignments of Roman River, Rivenhall Brook and Domsey Brook were straightened as a result of the construction of the existing A12. As a realignment is required for the proposed scheme, this was seen as an opportunity to improve the hydromorphology of the channels. Therefore, a gently sinuous planform has been incorporated into the preliminary design.

14.10.61 To further improve morphological variation along the realignments, sediment augmentation would create self-cleaning channels replicating pool-riffle sequences. This would also regulate flows and allow for further habitat creation. The arrangement and size of the coarse grains, as well as the channel dimensions of each geomorphic unit (i.e. riffle or pool) would require consultation with a geomorphologist. This would also involve site visits, sediment sampling and topographic survey to accurately calculate these.

14.10.62 Following consultation with the Principal Contractor, the drainage channel and Ordinary Watercourse realignments (Ordinary Watercourses 1, 2, 7, 9, 10, 12, 13, 13a, 15, 17, 18, 21a, 24, 26 and 37b) would be excavated as gently sinuous channels to further facilitate the improvement of hydromorphological processes. Two-stage channel cross-sections were not agreed upon; instead, pushing the bank-tops back was agreed to prevent rectangular cross-sections.

Groundwater

14.10.63 At this stage, no opportunities for enhancement to groundwater have been identified.

Flood risk

14.10.64 At this stage, no opportunities for enhancement to flood risk have been identified.

14.11 Assessment of likely significant effects

14.11.1 The assessment of likely significant effects upon road drainage and the water environment takes into account the application of the mitigation measures included in Section 14.10 of this chapter.

Construction

Surface water quality

14.11.2 Construction works have the potential to cause a reduction in water quality through contaminated construction runoff, and the risk of chemical spillages from plant, equipment and materials. Where construction works are undertaken in close proximity to, within, over or under watercourses, lakes and ponds, or close to existing land drains, this poses the greatest risk. Impacts could be short-term or long-term, permanent or temporary depending upon the pollutants, timing and receiving environment. Any pollution from construction activities that enters a watercourse has the potential to indirectly impact any downstream abstractions.

14.11.3 For sediment pollution and the use of polluting substances pre-mitigation there is anticipated to be a major adverse impact upon all watercourses, ponds and lakes that are adjacent to or within working areas, and any abstractions along these watercourses. Standard mitigation includes adherence to the measures set out in Appendix F – Emergency procedures and record of any environmental incidents, of the first iteration EMP [TR010060/APP/6.5] and actions within the water management plan. There is always a residual risk of accidental spillage incidents occurring that could have an adverse effect on surface water bodies and abstractions. However, with mitigation this impact is reduced to negligible. This results in a non-significant effect of **slight adverse** for high value receptors (River Chelmer, River Blackwater, Roman River, Boreham Brook/Tributary, Domsey Brook, River Brain, River Ter, and some ponds (P91, P98, P345, P7) and a **neutral** effect for all other receptors of medium and low value. The effect also applies for any abstractions located along the watercourses.

14.11.4 Some elements of the proposed scheme are likely to impact on groundwater level, flow and quality due to requirements for groundwater dewatering, typically related to earthworks (i.e. borrow pits, excavations, structures/pilings and cuttings). These activities may also affect the flows and quality in adjacent watercourses if the discharge is released into nearby surface waters. Such discharges may contain elevated levels of sediments and/or contaminated groundwater. De-watering impacts are discussed in Section 3 of Appendix 14.4 [TR010060/APP/6.3], and the assessment presented in the groundwater section of Section 14.11 of this chapter.

14.11.5 Activities at site compounds can include refuelling, concrete batch mixing and storage of polluting substances. Site compounds also require their own site drainage and disposal of effluent and sewerage. Without mitigation these activities can have a major adverse impact upon surface waters that are adjacent or near to site compounds. Mitigation would include treatment prior to discharge as detailed in the first iteration of the EMP [TR010060/APP/6.5]. Foul water from welfare facilities would either be stored in tanks and emptied regularly into a tanker for off-site disposal at a suitable wastewater management facility, or discharged to the existing main sewerage network, or to watercourses following suitable treatment. With this mitigation the magnitude of impact is anticipated to be reduced to negligible. This results in a non-significant effect of **slight adverse** for the River Chelmer, (125m east of J19 East satellite

compound) and a **neutral** effect for other watercourses (Watercourses 7, 12 and 39) of low value.

14.11.6 Water may also be used during dust suppression giving rise to runoff containing high levels of fine particles. The water required for dust suppression would involve the use of water as a resource. Where water would be sourced from watercourses this would require an abstraction licence, unless exempt, which would be subject to conditions to ensure any impact is acceptable to the receiving water environment. Where storage ponds are created, which may be fed by de-watering of excavations, groundwater, rainfall or indirectly by runoff from the road surfaces and working areas, these could be used as a water source for dust suppression. This may reduce baseflow and overland flow contributions to nearby watercourses leading to a reduction in flows, which would be exacerbated during times of low flows (i.e. in dry weather when dust suppression is likely to be required more frequently). Without mitigation this would have a moderate adverse impact upon watercourse flows which would be temporary and short term in duration. Mitigation includes adhering to the Water Management Plan, obtaining abstraction licences where required and adhering to conditions, and if required using alternative water supplies for dust suppression (i.e. tankering or connection to mains supply). With mitigation the impact is reduced to negligible. This results in a non-significant effect of **slight adverse** for high value receptors (River Chelmer, River Blackwater, Roman River, Boreham Brook/Tributary, Domsey Brook, River Brain, River Ter) and a **neutral** effect for all other receptors of medium and low value.

14.11.7 The gas main diversion has the potential to cross a number of watercourses of low or high value. However, the gas main diversion would be carried out through trenchless crossing beneath watercourses designated as Main Rivers. For minor watercourses, a trenchless crossing would be recommended, however, it is acknowledged that this may not be feasible and therefore this assessment assumes open cut crossings. With appropriate mitigation during the works outlined in the REAC, within the first iteration of the EMP [TR010060/APP/6.5], this action would have a **negligible** impact on surface water quality as an overall **slight adverse** effect on high value receptors, and a **neutral** effect on low value receptors.

14.11.8 Table 14.13 summarises the assessment of construction phase surface water quality and resources impacts.

Table 14.13 Summary of residual effects of construction to surface water quality and water resources

Receptor	Value	Description of impact, pathway and scale/risk	Magnitude of impact (with mitigation)	Significance of effect
River Chelmer, River Blackwater, Roman River, Boreham Brook/Tributary, Domsey Brook, River Brain, River Ter, and some ponds (P91, P98, P345, P7) Abstractions of surface water from watercourses	High	Sediment pollution from construction activities Risk of pollution from the use of polluting substances and accidental spillages Risk of pollution from trenchless crossing for gas main diversion	Negligible	**Slight adverse**
All other surface water receptors (Table 14.8) within the proposed scheme extent Abstractions of surface water from watercourses	Medium and low	Sediment pollution from construction activities Water used for dust suppression potentially reducing flows within watercourses Risk of pollution from the use of polluting substances and accidental spillages Risk of pollution from gas main diversion	Negligible	**Neutral**
River Chelmer	High	Site compound activities (i.e. refuelling, concrete batching, asphalt making, waste storage)	Negligible	**Slight adverse**
Watercourses 7, 12 and 39	Low	Site compound activities (i.e. refuelling, concrete batching, asphalt making, waste storage)	Negligible	**Neutral**
River Chelmer, River Blackwater, Roman River, Boreham Brook/Tributary, Domsey Brook, River Brain, River Ter, and some ponds (P91, P98, P345, P7)	High	Water used for dust suppression potentially reducing flows within watercourses	Negligible	**Slight adverse**

Hydromorphology

14.11.9 The assessment of effects for hydromorphology are included in Table 14.14.

WFD Regulations compliance

14.11.10 Details relating to the compliance of the proposed scheme in relation to the WFD Regulations are found in Appendix 14.2 [TR010060/APP/6.3]. In summary, most construction activities would lead to negligible impacts to water quality elements across the proposed scheme.

14.11.11 Negative construction impacts arising from the proposed scheme include loss of natural channel, impediment to fish passage in culverts and reduction of naturalised sections. With mitigation measures in place these effects are unlikely to be significant. Given the water body scale, construction impacts are likely to remain localised to the proposed scheme. In summary, the scheme complies with the requirements of the Water Framework Directive Regulations.

Table 14.14 Construction phase hydromorphological residual effects

Location of proposed scheme interaction with receptor	Importance of watercourse	Magnitude of scheme impact	Mitigation of impact	Residual effect
River Brain	Medium	Minor adverse In-channel works from the widening of Brain Bridge would likely lead to a reduced sediment availability due to sediment compaction. Furthermore, in-channel works (including fluming) and piling in flow dynamics could also lead to scour of bed and banks.	No additional mitigation required.	**Slight adverse**
River Blackwater	High	Minor adverse Bankside and in-channel works associated with the transposing of Ashman's Footbridge and the extension of Ashman's Bridge (including bank excavations for sheet piling) respectively, are likely to lead to localised scour of the banks. Scoured material would then smother local bed substrate material.		
Domsey Brook	Medium	Minor adverse Bankside works (concrete kicker walls and piling) would likely lead to localised scour of the banks during the extension of Domsey Bridge. Piping, which would enable flow conveyance during earlier stages of construction could lead to sediment accumulation at the inlet. However, this would not be a significant deviation from current baseline conditions at Domsey Bridge.		

Location of proposed scheme interaction with receptor	Importance of watercourse	Magnitude of scheme impact	Mitigation of impact	Residual effect
Roman River	Medium	Minor adverse The extension of Roman River Culvert would likely lead to localised scour of the bed and banks.	No additional mitigation required.	**Slight adverse**
Rivenhall Brook, Domsey Brook, Ordinary Watercourse 11	Medium	Minor adverse Construction of culverts could likely lead to localised scour along the banks of the watercourse. Furthermore, in-channel works could reduce sediment availability for downstream reaches.		
Ordinary Watercourse 1a, 1, 2, 9, 10 and 17	Low			
Ordinary Watercourse 21a, 23 and 37	Low	Negligible adverse Watercourses act as surface water pathways, therefore effects would be limited to scour during/following a large rainfall event.		**Neutral**
All scoped-in watercourses	Low to high	Negligible adverse Increases in fine sediment arising from construction of the proposed scheme could lead to localised smothering of bed substrate material.		
		Minor adverse Loss of riparian vegetation could lead to localised scour of the impacted banks.		**Slight adverse**

Location of proposed scheme interaction with receptor	Importance of watercourse	Magnitude of scheme impact	Mitigation of impact	Residual effect
River Blackwater	High	Minor adverse Construction of the outfalls would largely take place offline from the watercourse. Effects would arise when tying the outfall to the watercourse following construction. This could lead to localised scour of the impacted bank.	No additional mitigation required.	**Slight adverse**
River Chelmer, Boreham Brook, River Ter, River Brain, Domsey Brook, Roman River, Ordinary Watercourse 11	Medium			
Ordinary Watercourses 1a, 1, 2, 9, 10, 12, 13, 13a, 15, 17, 21a, 23, 24, 26, 31/31b, 32, 37, 38, 38b, 39, 40 and 41	Low			
Ordinary Watercourse 15a	Low	Negligible adverse As a surface water flow path, effects would be limited to localised scour following a heavy rainfall event.		**Neutral**
Rivenhall Brook, Roman River, Domsey Brook	Medium	Minor adverse Realignments to take place offline from existing watercourse. Scour of bed and banks to occur once realignments are tied-in to the existing channel. Such effects are likely to be localised to the tie-in areas.		**Slight adverse**
Ordinary Watercourses 1, 2, 7, 9, 10, 12, 12a, 15, 17, 21, 21a, 23, 24, 26, 26a, 34, 37, 37b, 38, 38b, 41,	Low			
Ordinary Watercourse 34b and 34c	Low	Negligible adverse As surface water pathways, any effects from channel realignments would be limited to localised scour during/following periods of heavy rainfall.		**Neutral**

Location of proposed scheme interaction with receptor	Importance of watercourse	Magnitude of scheme impact	Mitigation of impact	Residual effect
River Blackwater	High	Minor adverse Changes to flow dynamics as a result of temporary construction drainage could lead to localised scour of the bed and banks.	No additional mitigation required.	**Slight adverse**
Boreham Brook, River Ter, River Brain, Domsey Brook, Ordinary Watercourse 11	Medium			
Ordinary Watercourses 2, 7, 9, 12, 13, 17, 18, 21, 23 24, 32, 37, 38b and 39	Low			
Ordinary Watercourse 15a	Low	Negligible adverse As surface water pathways, any effects from temporary construction drainage would be limited to localised scour during/following periods of heavy rainfall.		**Neutral**
Boreham Brook, Domsey Brook, Roman River and Ordinary Watercourse 11	Medium	Negligible adverse Haul roads crossing here would use existing access track. Effects would include increased levels of fine sediment smothering local bed substrate, mitigated through a sediment management plan.		**Neutral**
Ordinary Watercourses 1a, 1, 2, 10, 17, 18 and 21 and Ponds P133, P40 and P455	Low			
River Brain	Medium	Negligible adverse Haul road would cross channel via a bailey bridge. Effects would be fine sediment from the haul road smothering bed substrate material, mitigated through a sediment management plan.		**Neutral**

Location of proposed scheme interaction with receptor	Importance of watercourse	Magnitude of scheme impact	Mitigation of impact	Residual effect
Ordinary Watercourse 21a	Low	Moderate adverse Combination of culvert crossing and realignment could lead to scour of the local bed and banks. Channel instabilities could propagate upstream and downstream.	No additional mitigation required.	**Slight adverse**
Ponds P68, P69, P455	Low	Minor adverse Construction activities would likely lead to loss of bank material and input of fine sediment.		**Slight adverse**
Ponds P43, P63, P64, P68, P69, P70, P87 and P354	Low	Minor Adverse Construction activities would lead to loss of bank material.	Replacing the lost ponds with seven new ponds	**Neutral**
River Blackwater	High	No change Gas main diversions are to be carried out through trenchless crossing beneath Main Rivers. Therefore, no changes anticipated.	None required	**Neutral**
Ordinary Watercourse 9f, 9g, 9h, 9i	Low	Moderate adverse Open cut crossings during construction of the gas main diversion would likely lead to destabilisation of the bank material and compaction of bed substrate material. As these watercourses are also artificial, channel instability could occur, if active. However, baseline assessment evaluated them as being largely dry.		**Slight adverse**

Groundwater

Impacts from construction dewatering

14.11.12 The detailed assessment of impacts associated with construction dewatering are presented in Sections 3 and 6 of Appendix 14.4 [TR010060/APP/6.3].

14.11.13 Considering the scale of the superficial aquifers across and beyond the study area, the proposed works would be expected to have a minor adverse magnitude of impact, resulting in a potential **neutral** effect on unproductive strata (Peat, Interglacial lacustrine deposits); **slight** on Secondary B and Secondary Undifferentiated aquifers (Brickearth, Lowestoft Formation (Glacial Till), Head deposits); and **slight** on Secondary A aquifers (Glacio-fluvial deposits, River Terrace Deposits, Alluvium, Kesgrave Catchment Subgroup (sand and gravel)).

14.11.14 Impacts on some of the groundwater abstractions were identified in Sections 3 and 6 of Appendix 14.4 [TR010060/APP/6.3] and would be dealt with by the additional mitigation measures detailed in Section 14.10 of this chapter, resulting in a **slight** or **neutral** effect as a result of dewatering.

14.11.15 Impacts associated with the discharge of potentially contaminated groundwater from dewatering activities are presented in the WQAR (Appendix 14.1 [TR010060/APP/6.3] and could have significant impacts. However, standard and additional mitigation measures presented in Section 14.10 of this chapter would mitigate any risks associated with discharge of potentially contaminated groundwater resulting in a **neutral** effect.

14.11.16 As discussed in Section 4 of Appendix 14.4 [TR010060/APP/6.3], a preliminary differential settlement assessment has been undertaken and several buildings could be impacted. However, with the implementation of additional mitigation measures prior to the relevant works being undertaken, the likely effects would be **slight**.

14.11.17 As discussed in Section 3 of Appendix 14.4 [TR010060/APP/6.3], dewatering impacts on surface water features would result in a **neutral** or **slight** effect, without any mitigation measures required.

14.11.18 With the implementation of additional mitigation measures for Wet Woodland 7, the residual effects during the construction of borrow pit I are expected to be **slight**. As discussed in Section 5 of Appendix 14.4 [TR010060/APP/6.3], other construction effects on GWDTEs would be **slight** or **neutral** taking into account standard mitigation measures.

Impacts on groundwater quality from construction activities

14.11.19 With the implementation of the standard mitigation measures detailed in Section 14.10 of this chapter, the effects on groundwater quality from accidental spillages in the secondary aquifers are likely to be negligible, giving a **neutral** effect to these receptors.

14.11.20 When considering the additional mitigation measures detailed in Section 14.10 of this chapter, the residual magnitude of impact on water quality of groundwater abstractions is considered to be negligible, resulting in a **slight** or **neutral** effect.

14.11.21 As discussed in Section 5 of Appendix 14.4 [TR010060/APP/6.3], and after implementation of standard mitigation measures, effects on water quality supporting GWDTEs are expected to be **neutral** to **slight**.

Impacts from piling and foundation activities

14.11.22 After implementation of standard mitigation measures, piling works activities are assessed to have a residual **slight** or **neutral** effect.

Other impacts

14.11.23 Any groundwater flow alterations resulting from compaction effects are expected to be negligible at the scale of the aquifers. Potential impacts on GWDTEs are discussed in Section 5 of Appendix 14.4 [TR010060/APP/6.3] and would result in **slight** or **neutral** effects.

14.11.24 Any changes to recharge to the aquifers are expected to be negligible and therefore result in a **neutral** effect, with no mitigation required.

Flood risk

14.11.25 Subject to the implementation of all compensation and mitigation measures (as listed in the REAC, within in the first iteration EMP [TR010060/APP/6.5]), it is anticipated that the post-mitigation significance of flood risk effects during the construction phase would be neutral. The FRA (Appendix 14.5 [TR010060/APP/6.3]) provides details of how the proposed mitigation would achieve this.

Operation

Surface water quality: routine runoff

14.11.26 Routine runoff simple assessments have been undertaken using HEWRAT. The full details of the methodology, data used and results at this stage are presented in the WQAR (Appendix 14.1 [TR010060/APP/6.3]). The results of the HEWRAT assessments have been used to inform the magnitude of impact. This has been reported, along with the significance of effect, in the WQAR (Appendix 14.1). This section provides a summary of the results. Data used in the assessment are presented in Annex B and C of Appendix 14.1. The receiving watercourses are shown in Figure 14.1 [TR010060/APP/6.2].

14.11.27 Simple-level assessments have been undertaken for soluble and sediment-bound pollutants in HEWRAT at Step 2 (pre-mitigation) for all 92 single outfalls for watercourses receiving highway runoff from the proposed scheme. Of these outfalls, 31 have been assessed for impacts to surface waters. The remaining 61 outfalls have been assessed for their impact upon surface waters using HEWRAT, but given they discharge to low-flow watercourses, groundwater assessments have been undertaken. For these outfalls their magnitude of impact has been established through the groundwater assessment results. The Step 2 and Step 3 HEWRAT results for all 92 outfalls are presented and described in detail in Appendix 14.1 [TR010060/APP/6.3], as well as the results of the groundwater assessments.

14.11.28 Of the 31 outfalls assessed for surface water effects, 26 pass all DMRB LA 113 standards (Highways England, 2020a) (i.e. EQS, runoff specific thresholds (RST), and sediment impact) at Step 2 (i.e. without consideration of mitigation). For the five outfalls which did not pass the HEWRAT assessments at Step 2, one failed for sediment-bound pollutants (to Ordinary Watercourse 17), and two failed the RST for copper (to Rivenhall Brook and Roman River). The remaining two outfalls, both to Domsey Brook, both failed for sediment-bound pollutants, RSTs for copper and the EQS for copper.

14.11.29 When embedded mitigation is incorporated into the assessment (i.e. Step 3) and the outfalls are considered individually, all of the 31 outfalls achieve the DMRB LA 113 standards. 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. For those outfalls which pass at Step 2 the embedded mitigation would provide a betterment above the DMRB standards and legal requirements. It would also provide a betterment upon the existing situation as the A12 does not currently have any treatment for water quality.

14.11.30 Of the 12 cumulative outfall assessments undertaken, six pass all DMRB LA 113 standards (RSTs, EQS and chronic sediment impact) at the Step 2 stage of the assessment (i.e. without mitigation). For these outfalls the treatment of water quality to be provided through SuDS would be a betterment against the DMRB standards and compared to the existing situation for the existing outfalls. For the six cumulative assessments which did not pass the HEWRAT assessments at Step 2, four outfalls fail due to RST failures. The remaining two fail both the EQS for copper and the RSTs for copper.

14.11.31 At Step 3 of the 12 cumulative outfall assessments, 11 pass all DMRB standards with embedded mitigation. Outfalls (S3 – OU17 and OU18) to the Roman River fail the RST24 for copper, resulting in a minor adverse magnitude of impact and an overall significance of effect of **slight adverse** for the receiving watercourse Roman River, a high value receptor.

14.11.32 Outfall S3_OU17 includes a filter drain for approximately a third of the catchment and attenuation pond for 90% of the catchment. This catchment comprises approximately 6ha of the existing A12 and 1.3ha of new impermeable surfacing for widening the carriageway in this location. Currently this catchment does not include any treatment for water quality and thus the treatment that would be provided by the proposed scheme would be a betterment compared to the existing situation. S3_OU18 includes online storage in oversized pipes which does not provide any treatment for this 1.8ha catchment. However, this outfall passes the single outfall assessment and of this 1.8ha catchment, approximately 0.3ha is new impermeable surfacing, with the remaining 1.5ha being existing and currently receiving no treatment. The outfall is located at the low point in the catchment to allow adequate drainage, however due to space constraints in this location, there is no space available between the drainage catchment and the Roman River to include solutions which would provide water quality treatment for solubles.

Surface water quality: spillage risk assessments

14.11.33 The probability that an accidental spillage would lead to a serious pollution incident has been calculated for each road catchment and for the cumulative outfalls. As DMRB LA 113 guidance (Highways England, 2020a) stipulates, a simple-level spillage risk assessment has been undertaken for the proposed scheme using HEWRAT. Results show that all discharges from the proposed scheme pass with an annual probability of a serious pollution incident calculated to be less than the 0.5% (1 in 200) AEP event. This is within acceptable limits, and thus mitigation is not deemed to be required. All the catchments have returned an acceptable standard of spillage risk. Full results are included within Appendix 14.1 [TR010060/APP/6.3] of the Environmental Statement. It is predicted that the potential impact on the receiving watercourses is permanent, long-term but negligible, resulting in a neutral or slight adverse (not significant) effect depending on the value (very high to medium) of each water body.

Surface water quality: surface de-icing

14.11.34 Pollution from maintenance activities during the operational phase, such as the use of de-icing salts as a result of responsive activities, are difficult to predict and design for. When temperatures are around 4°C or lower, de-icing salts would likely be applied (when required) to the proposed scheme to maintain a safe driving surface and to help clear away any snowfall. The application of de-icing salts tends to be intermittent and can be very variable between years depending on how many cold days there are, and how long the cold period lasts. During this time, highway runoff (that may also include snowmelt) may contain sodium chloride (NaCl) and lesser amounts of clay, cyanide, sediment, and a number of metals. De-icing salts can also be corrosive to metals and may potentially increase the mobilisation of heavy metals in sediments (such as in highway treatment ponds). Similarly, NaCl can potentially trigger the release into solution of accumulated nutrients and heavy metals absorbed to suspended solids.

14.11.35 Generally, it is considered that long-term adverse effects are not likely to occur from the use of de-icing salts. SuDS systems where there are currently none, may also provide some dilution of salt. Overall, it is considered that there would be a negligible impact on the larger rivers (those of high value) and seasonal but long-term and temporary minor adverse impacts on all other receiving watercourses. This would result in a **slight adverse** effect on all receiving watercourses. This would be a betterment upon the existing situation as currently the A12 does not have any treatment for water quality.

Pond loss

14.11.36 Eight ponds within the footprint of the proposed scheme would be lost. All are considered to be low-value receptors on the basis of the potential absence of GCN. The two ponds that may have partial impacts as a result of the proposed scheme are also of low value.

14.11.37 The proposed scheme would compensate for the loss of these ponds through the creation of new ponds, resulting in an overall greater number compared to the existing situation. This mitigation would result in an overall negligible magnitude of impact. Considering all ponds as low-value receptors, this would result in a **neutral** significant effect.

14.11.38 The magnitude of impact and significance of effect for the operational stage is presented in Table 14.15 for the surface water environment.

Table 14.15 Overall operational surface water quality significance of residual effect

Receptor	Importance	Mitigation	Magnitude of impact	Significance of effect
River Chelmer	High	S1 – OU01: filter drain, underground storage + attenuation pond Risk of pollution from spillages <0.5%	Negligible (routine runoff and spillage risk)	**Slight adverse**
Boreham Brook	High	S1 – OU10: underground storage units S1 – OU10A: underground storage units S1 – OU11: filter drain + attenuation pond S1 – OU12: attenuation pond Risk of pollution from spillages <0.5%	Negligible (routine runoff and spillage risk)	**Slight adverse**
River Ter	High	S1 – OU13: attenuation pond S1 – OU15: online storage S1 – OU17: filter drain Risk of pollution from spillages <0.5%	Negligible (routine runoff and spillage risk)	**Slight adverse**
River Brain	High	S2 – OU04: attenuation pond S2 – OU05: online storage Risk of pollution from spillages <0.5%	Negligible (routine runoff and spillage risk)	**Slight adverse**

Receptor	Importance	Mitigation	Magnitude of impact	Significance of effect
River Blackwater	High	S2 – OU15D1: ditch S2 – OU18: attenuation pond S2 – OU19: attenuation pond S2 – OU27: online storage S3 – OU01: filter drain + attenuation pond S3 – OU05: attenuation pond Risk of pollution from spillages <0.5%	Negligible (routine runoff and spillage risk)	**Slight adverse**
Rivenhall Brook	Medium	S2 – OU15G: attenuation pond S2 – OU24: online storage S2 – OU24A: attenuation pond Risk of pollution from spillages <0.5%	Negligible (routine runoff and spillage risk)	**Neutral**
Watercourse 17	Low	S2 – OU15H: attenuation pond Risk of pollution from spillages <0.5%	Negligible (routine runoff and spillage risk)	**Neutral**
Existing highways drainage network	Low	S2 – OU17: no treatment Risk of pollution from spillages <0.5%	Negligible (routine runoff and spillage risk)	**Neutral**

Receptor	Importance	Mitigation	Magnitude of impact	Significance of effect
Domsey Brook d/s	High	S3 – OU08: attenuation pond S3 – OU08A: filter drain + attenuation pond S3 – OU09: attenuation pond S3 – OU10: filter drain + attenuation pond S3 – OU19: filter drain + attenuation pond S3 – OU30: filter drain + double attenuation pond S3 – OU30A: filter drain + double attenuation pond Risk of pollution from spillages <0.5%	Negligible (routine runoff and spillage risk)	**Slight adverse**
Roman River	High	S3 – OU17: filter drain + attenuation pond S3 – OU18: online storage Risk of pollution from spillages <0.5%	Negligible (routine runoff and spillage risk)	**Slight adverse**
Watercourse 38	Low	S3 – OU26B: attenuation pond Risk of pollution from spillages <0.5%	Negligible (routine runoff and spillage risk)	**Neutral**
Ponds P43, P63, P64, P68, P69, P70, P87 and P354	Low	Replacing each pond lost with at least seven new ponds (GCN to be removed from pond under licence - as described in Chapter 9: Biodiversity [TR010060/APP/6.1])	Negligible (pond loss due to development)	**Neutral**

Receptor	Importance	Mitigation	Magnitude of impact	Significance of effect
River Chelmer, River Blackwater, Roman River, Boreham Brook/Tributary, Domsey Brook, River Brain and the River Ter	High	Rock salt typically used to avoid reduction in BOD. Apply in accordance with standard practice and procedures.	Negligible (use of de-icing salts)	**Slight adverse**
All other watercourses (Table 14.8) within the scheme extent	Medium and low	Rock salt typically used to avoid reduction in BOD. Apply in accordance with standard practice and procedures.	Minor adverse (use of de-icing salts)	**Slight adverse**
River Blackwater	High	The gas main diversion would be positioned below the ground and trenchless methods used beneath any Main River it crosses.	No change (gas main diversion)	**Neutral**
Watercourses 9b, 9c, 9d, 9e, 9f, 9g, 9h	Low	It is assumed that the gas main diversion would be positioned below the ground and open cut methods used for Ordinary Watercourses it crosses.	No change (gas main diversion)	**Neutral**

Hydromorphology

14.11.39 Overall, the significance of residual scheme impacts (after mitigation measures have been applied) on hydromorphology, ranges from slight adverse to slight beneficial (as outlined in Table 14.16).

Table 14.16 Operational phase hydromorphology significance of residual effects

Receptor	Importance	Additional mitigation	Magnitude of scheme impact	Significance of effect
River Brain	Medium	None required	Minor adverse Bridge widening would improve channel constrictions, however localised scour is an issue with placement of bridge abutment.	**Slight adverse**
Rivenhall Brook	Medium	Gravels along the bed of the culvert	Minor adverse Realignment likely to lead to localised changes in sediment availability, erosion and aggradation, development of bedforms and stability of morphological features.	**Slight adverse**
	Medium	Gravel augmentation in the form of a pool-riffle sequence	Moderate adverse Realignment along Rivenhall Brook would significantly shorten the existing watercourse, impeding natural morphological behaviour and causing channel instability downstream.	**Slight adverse**
River Blackwater	High	None required	Minor adverse Localised bank scour likely to take place at Ashman's Bridge as a result of likely changes in flow dynamics (eddies).	**Slight adverse**
Domsey Brook	Medium	None required	Minor adverse Proposed extension of Domsey Bridge would likely lead to changes in localised flow and sediment dynamics and bank and bed erosion along the channel.	**Slight adverse**

Receptor	Importance	Additional mitigation	Magnitude of scheme impact	Significance of effect
Domsey Brook	Medium	None required	Minor benefit The realignment immediately upstream of Domsey Bridge would be an improvement on existing morphology, including improved sinuosity and sediment/morphological continuity conditions along the channel.	**Slight beneficial**
Domsey Brook	Medium	Place gravels along culvert bed	Minor adverse The Domsey Brook culvert (east) is likely to cause localised and temporary scour of the bed and banks along the newly realigned reach.	**Slight adverse**
Roman River	Medium	None required	Minor adverse The extension of the Roman River culvert could lead to localised changes in flow dynamics and morphological behaviour. Effects likely to remain local to culvert.	**Slight adverse**
Roman River	Medium	None required	Minor beneficial The realignment along Roman River would extend the watercourse by a further 10m. This could lead to reduced flow velocities, change in development of morphological features and localised sediment aggradation. There may also be an improvement to riverine morphology.	**Slight beneficial**
Ordinary Watercourse 11	Medium	Bank protection installed downstream of the culvert; and monitoring of the watercourse to assess protection efficacy.	Moderate adverse Artificial alteration to bed and bank material distribution and size; potential scour at the outlet, whilst increased accretion of sediment could occur at the inlet.	**Minor adverse**

Receptor	Importance	Additional mitigation	Magnitude of scheme impact	Significance of effect
Ordinary Watercourse 15a	Low	None required	Moderate adverse The proposed offline highway structure at Rivenhall End and realignment of Rivenhall Brook would cut this off-take channel from its source (Rivenhall Brook). This would lead to prolonged periods of dryness along the watercourse, and areas of active watercourse would be lost. However, this would not lead to significant deviation from baseline conditions. Furthermore, in its place, an attenuation pond would outfall into the watercourse and provide it with a new source.	**Slight adverse**
Ordinary Watercourses 1, 2, 7, 9, 10, 12, 12a, 13, 15, 17, 18, 21, 21a, 23, 24, 26, 26a, 37, 37b, 38, 38b, 41	Low	None required	Moderate adverse The proposed drainage culverts along these Ordinary Watercourses combined with the proposed realignments could lead to localised scour of the bed and banks. These effects would largely be concentrated at the culvert.	**Slight adverse**
Ordinary Watercourses 1a and 23	Low	None required	Minor adverse The proposed culverts would likely lead to scour of the bed and banks, as well as increased (localised) sediment aggradation at their inlets and outlets. Any changes would be temporary, ceasing once the channels have adjusted to the culverts.	**Slight adverse**
River Chelmer, Boreham Brook, River Ter, River Blackwater, Domsey Brook, Roman River	Medium	Install bank protection which extends from the outfall and monitor for efficacy	Moderate adverse Outfalls along these watercourses are all located either directly on channel bends or near to them. Their presence can disrupt secondary flow paths, altering the natural processes and potentially causing scour.	**Slight adverse**

Receptor	Importance	Additional mitigation	Magnitude of scheme impact	Significance of effect
Ordinary Watercourses 1a, 31, 31b, 32, 15a, 40 and 41	Low	Set back outfalls, align them 45° facing downstream, submerge outfall pipe below waterline (if practicable)	Minor adverse The disturbance of bed and bank material from the presence of the outfall, as the channel adjusts to it, would lead to localised scour.	**Slight adverse**
Ordinary Watercourses 2, 7, 9, 10, 11, 12, 13, 13a, 17, 18, 21a, 23, 24, 26, 37, 37b, 38, 38b, 39 and 42	Low	None required	Minor adverse The combined effect of both outfall structures and cut-off drain confluences could lead to disturbances of the bed and banks of each watercourse, including scour. Long-term effects could include sediment aggradation at the confluences and discontinuity in sediment and morphological behaviour.	**Slight adverse**
River Chelmer, Boreham Brook, River Ter, Domsey Brook, Roman River	Medium	Set back outfalls, align them 45° facing downstream, submerge outfall pipe below waterline (if practicable).	Negligible adverse Potential, but negligible, change to flow dynamics and sediment entrainment could take place as flow enters the watercourses from new locations as a result of drainage.	**Neutral**
Ordinary Watercourses 1a, 2, 7, 9, 10, 11, 12, 13, 13a, 17, 18, 21a, 23, 24, 26, 37, 37b, 38, 38b, 40, 41 and 42	Low			
River Blackwater	High			

Receptor	Importance	Additional mitigation	Magnitude of scheme impact	Significance of effect
Ordinary Watercourse 7	Low	None required	Minor adverse The proposed bund would lead to localised flow impoundment, and increased sediment accretion within the bund.	**Slight adverse**
Ordinary Watercourses 18, 21, 21a and 26	Low	None required	Minor beneficial Flood compensation areas would provide the channel with improved connectivity to floodplains and floodplain sediments. Localised scour, in the form of runnels, could take place as flood flows recede. However, the benefits of an improved floodplain connection would offset this.	**Slight beneficial**
Ordinary Watercourse 34	Low	None required	Moderate adverse Realignment to the drainage channel along Inworth Road would likely lead to scour following periods of heavy rainfall.	**Slight adverse**
Ordinary Watercourse 34b and 34c	Low	None required	Negligible adverse The realignment of ditches to capture surface waters would likely lead to changes in flow conditions once active, and in morphological behaviour. However, this would be limited to active periods following heavy rainfall events.	**Neutral**
Ordinary Watercourses 34b and 34c	Low	None required	Negligible adverse The presence of flood mitigation areas (excavated storage areas) would lead to surface water ponding and attenuating flows re-entering the surface water drainage network, increasing the risk of fine sediment settlement. Ponding is likely to be localised to the flood mitigation area and limited to flood events when the watercourse becomes active.	**Neutral**

Receptor	Importance	Additional mitigation	Magnitude of scheme impact	Significance of effect
Ordinary Watercourse 34, and 34c	Low	None required	Negligible adverse Outfalls and off-cut drainage ditches would discharge into the existing Ordinary Watercourse 34 and the newly aligned Ordinary Watercourse 34c, increasing the sediment load and risk of scour following heavy rainfall events.	**Neutral**
River Blackwater	High	None required	No change The gas main diversion would be positioned below the ground and beneath any Main River it crosses.	**Neutral**
Ordinary Watercourses 9e, 9f, 9g, 9h, 9i	Low	None required	No change No operational impacts anticipated on watercourses, as open cut corridor for gas main diversion would only take place during construction.	**Neutral**
Ponds P43, P63, P64, P68, P69, P70, P87 and P354	Low	None required	Replacing each pond lost with at least seven new ponds	**Neutral**

WFD Regulations compliance

14.11.40 Further details on the operational impacts to the water quality elements of potentially affected WFD Regulations surface water and groundwater bodies are found in the detailed WFD Regulations compliance assessment in Appendix 14.2 [TR010060/APP/6.3]. Generally, the proposed scheme would lead to negligible changes to water elements. However, the following would lead to negative changes, which could be of adverse significance on a water body scale[1]:

- The outfall structures would lead to negative changes to hydromorphological quality elements (quantity and dynamics of flow, river width and depth, structure of the riparian zone) present at screened-in water bodies (the Chelmer, Boreham Tributary, Ter, Blackwater, Domsey Brook and Roman River). Such impacts would at most lead to a low risk of deterioration in these water quality elements following mitigation.

- The highway structure would lead to negative changes on biological quality elements. The presence of new culverts within Blackwater (combined Essex) water body and Domsey Brook would lead to loss of habitat for invertebrates and fish. Culvert crossings would also inhibit opportunities for macrophyte communities to grow whilst acting as obstacles for migratory fish. Most significant changes would be seen at Rivenhall Brook and overall, would lead to a moderate risk of deterioration in water quality elements. For Domsey Brook, such impacts would lead to a low risk of deterioration in the status of water quality elements.

- Hydromorphological elements would also be negatively changed as a result of the highway structure. Impacts would largely occur in the Blackwater (combined Essex) and Domsey Brook, as a result of the extended and/or proposed culvert crossings. The crossings would largely impact flow dynamics, river width and depth, and bed substrate. However, such impacts would likely lead to a low risk of deterioration.

- Groundwater of poor quality could be conveyed via drainage routes associated with road cuttings and widenings and significantly impact surface waters dependent on baseflow. However, with additional mitigation, such impacts would lead to a low risk of deterioration.

14.11.41 Conversely, the proposed scheme would also lead to positive changes in water quality elements. These include:

- Increased opportunities to improve macrophyte communities at the Domsey Brook realignment, as the watercourse would be moved away from the existing highway structure which shades the channel.

[1] Compliance with WFD does not assess impacts based on significance. Instead, its assessment is based on changes leading to potential risks of deterioration to the status of quality and supporting elements. Therefore, significance of effect is not discussed when summarising WFD compliance.

- The lengths of the realignments would provide refuge to fish with the addition of enhancements such as gravel augmentation (pools and riffles, etc). These would also work towards mitigating the impacts from watercourse crossings which provide negative changes to the water body.
- Realignments would provide positive changes to all the hydromorphological supporting elements across all screened-in surface water bodies. The gentle sinuous nature of the realignments and the enhancements discussed in Section 14.10 of this chapter, would all work to improve conditions present at each surface water body.

Groundwater

Groundwater levels and flow

14.11.42 Excavations at road cuttings and widenings are permanent earthworks. As a result, the dewatering impacts associated with road cuttings and widenings assessed in Section 3 of Appendix 14.4 [TR010060/APP/6.3] remain valid for the operational phase. With the implementation of embedded mitigation, residual effects are expected to be **neutral**.

14.11.43 Similarly, long-term dewatering or drainage for road cuttings and widenings result in **slight** or **neutral** effects on groundwater abstractions, when considering the additional mitigation measures detailed in Section 14.10 of this chapter, including those for LGA-7 and LGA-17. The residual magnitude of impact on groundwater abstractions is considered to be neutral.

14.11.44 Poor quality groundwater could continue to be mobilised towards the drainage system as a result of road cuttings and widenings, which could result in a significant impact on the receiving surface water receptors. However, when considering the additional mitigation measures detailed in Section 14.10 of this chapter and the negligible residual magnitude of impact, this would result in a **slight** or **neutral** effect on water quality issues.

14.11.45 No long-term dewatering effect is expected as a result of attenuation ponds and borrow pits where groundwater levels would be allowed to rebound. Long-term groundwater flow impacts are expected to be negligible resulting in a **neutral** effect.

14.11.46 Long-term dewatering impacts on surface water receptors and GWDTEs are expected to be **neutral** or **slight**. No mitigation measures are required.

14.11.47 Other long-term impacts on groundwater levels and flow relating to the operational phase are presented in the FRA (Appendix 14.5 [TR010060/APP/6.3]), including impacts resulting from embankments, below-ground structures such as sheet piles associated with retaining walls and groundwater recharge through flood compensation areas. No significant impact would be expected in terms of groundwater recharge. Embedded, standard and additional mitigation measures have been proposed for the other potential impacts. With the implementation of the proposed mitigation measures the proposed scheme would have a **neutral** effect on groundwater levels and flow.

Groundwater quality and routine runoff

14.11.48 Groundwater quality and routine runoff for the operational drainage, including from spills on the highway, are assessed in the WQAR (Appendix 14.1 [TR010060/APP/6.3]. The assessment concludes that there would be no impacts from the highway drainage to the groundwater environment and hence the scheme would have a **neutral** effect.

Flood risk

14.11.49 For watercourses investigated using hydraulic modelling, Table 14.17 details the residual significance (including additional mitigation outlined in Section 14.10 of this chapter) of proposed scheme impacts. For more detail of the proposed scheme's modelled flood risk (including pre-mitigation impacts), refer to the FRA (Appendix 14.5 [TR010060/APP/6.3]) and Annex L of the FRA (Hydraulic modelling reports).

14.11.50 For all other aspects of flood risk, Table 14.18 details the significance of proposed scheme impacts (pre-mitigation, and residual). For more detail of the proposed scheme interaction with flood risk refer to the FRA (Appendix 14.5).

14.11.51 Overall, the significance of residual impacts of the proposed scheme (after mitigation measures have been applied) on flood risk, ranges from slight adverse to very large beneficial (as outlined in Tables 14.17 and 14.18).

Table 14.17 Significance of residual effects for all modelled watercourse crossings

Location of proposed scheme interaction with modelled watercourse	Importance of floodplain[1]	Magnitude of scheme impact[2]	Residual effect[3]
Crossing of Ordinary Watercourse 7	Low: Floodplain contains no receptors classified as vulnerable to flooding	Major adverse: Would cause an increase in peak flood level (maximum increase >100mm) to agricultural or other greenfield land immediately upstream (to the north) of the watercourse crossing.	**Slight adverse:** DMRB LA 104 matrix (Highways England, 2020d) results in slight/moderate adverse significance of effect. A slight adverse significance of effect has been reported, as the area for which the proposed scheme would cause an increase in flood risk contains no receptors classified as vulnerable to flooding under DMRB LA 113 guidance (Highways England, 2020a) and would remain within the proposed scheme's permanent land take, would be owned by National Highways, and consequently would not impact other parties.
New offline crossing of Rivenhall Brook	Low: Floodplain contains no receptors classified as vulnerable to flooding	Major beneficial: Would cause a decrease in peak flood level (maximum decrease >100mm) to an area of agricultural or other greenfield land upstream of the existing A12 Rivenhall Brook culvert.	**Slight beneficial:** DMRB LA 104 matrix results in slight/moderate beneficial significance of effect. A slight beneficial significance of effect has been reported, as the area for which the proposed scheme would cause a reduction in flood risk contains no receptors classified as vulnerable to flooding under DMRB LA 113 guidance and the reduced flood risk is unlikely to impact current use.

Location of proposed scheme interaction with modelled watercourse	Importance of floodplain[1]	Magnitude of scheme impact[2]	Residual effect[3]
	Low: Floodplain contains no receptors classified as vulnerable to flooding	Major adverse: Would cause an increase in peak flood level (maximum increase >100mm) to a small area of agricultural or other greenfield land immediately downstream of the proposed new A12 Rivenhall Brook culvert).	**Slight adverse:** DMRB LA 104 matrix results in slight/moderate adverse significance of effect. A slight adverse significance of effect has been reported, as the area for which the proposed scheme would cause an increase in flood risk, contains no receptors classified as vulnerable to flooding under DMRB LA 113 guidance; it would remain within the proposed scheme's permanent land take, would be owned by National Highways, and consequently would not impact other parties.
Mainline crossing and footbridge crossing of River Blackwater	Low: Floodplain contains no receptors classified as vulnerable to flooding	Major adverse: Would cause an increase in peak flood level (maximum increase >100mm) to a small area of agricultural or other greenfield land immediately adjacent to the proposed Ordinary Watercourse 21 flood mitigation ditch).	**Slight adverse:** DMRB LA 104 matrix results in slight/moderate adverse significance of effect. A slight adverse significance of effect has been reported, as the area for which the proposed scheme would cause an increase in flood risk contains no receptors classified as vulnerable to flooding under DMRB LA 113 guidance; it would remain within the proposed scheme's permanent land take, would be owned by National Highways and consequently would not impact other parties (land would include proposed flood mitigation diversion ditch).

Location of proposed scheme interaction with modelled watercourse	Importance of floodplain[1]	Magnitude of scheme impact[2]	Residual effect[3]
	Low: Floodplain contains no receptors classified as vulnerable to flooding	Minor adverse: Would cause an increase in peak flood level (maximum increase 10-50mm) to a small area of agricultural or other greenfield land immediately upstream of the proposed footbridge ramp on the east side of the River Blackwater.	**Neutral**: DMRB LA 104 matrix results in neutral/slight adverse significance of effect. A neutral adverse significance of effect has been reported, as the area for which the proposed scheme would cause an increase in flood risk contains no receptors classified as vulnerable to flooding, and would remain within the proposed scheme's permanent land take, would be owned by National Highways and consequently would not impact other parties.
	Low: Floodplain contains no receptors classified as vulnerable to flooding	Minor beneficial: Would cause a decrease in peak flood level (maximum decrease 10-50mm) to a small area of agricultural or other greenfield land immediately downstream of the proposed footbridge ramp on the east side of the River Blackwater.	**Neutral**: DMRB LA 104 matrix results in neutral/slight beneficial significance of effect. A neutral beneficial significance of effect has been reported, as the area for which the proposed scheme would cause a decrease in flood risk contains no receptors classified as vulnerable to flooding under DMRB LA 113 guidance.
Crossing of Ordinary Watercourse 21 (including flood mitigation works)	Very high: Floodplain contains existing A12 - 'essential infrastructure'	Moderate beneficial: Would cause a decrease in peak flood level (maximum decrease 50-100mm) to the A12 carriageway.	**Very large beneficial:** DMRB LA 104 matrix results in large/very large beneficial significance of effect. A very large significance of effect has been reported, as the area for which the proposed scheme would cause a decrease in flood risk contains the A12 carriageway (classified as 'essential infrastructure' under DMRB LA 113 guidance).

Location of proposed scheme interaction with modelled watercourse	Importance of floodplain[1]	Magnitude of scheme impact[2]	Residual effect[3]
	High: Floodplain contains residential properties - 'more vulnerable development'	Moderate beneficial: Would cause a decrease in peak flood level (maximum decrease 50-100mm) to two properties downstream of the A12 crossing, near the confluence of Ordinary Watercourse 21 and the River Blackwater.	**Large beneficial:** DMRB LA 104 matrix results in moderate/large beneficial significance of effect. A large significance of effect has been reported, as the area for which the proposed scheme would cause a decrease in flood risk contains residential properties (classified as more vulnerable to flooding under DMRB LA 113 guidance).
	Low: Floodplain contains no receptors classified as vulnerable to flooding	Major adverse: Would cause an increase in peak flood level (maximum increase >100mm) to agricultural or other greenfield land upstream of the flood mitigation bund during the 5% (1 in 20) AEP event.	**Slight adverse:** DMRB LA 104 matrix results in slight/moderate adverse significance of effect. A slight adverse significance of effect has been reported as the area affected contains no receptors classified as vulnerable to flooding under DMRB LA 113 guidance and would remain within the proposed scheme's permanent land take, would be owned by National Highways, and consequently would not impact other parties.

Location of proposed scheme interaction with modelled watercourse	Importance of floodplain[1]	Magnitude of scheme impact[2]	Residual effect[3]
	Low: Floodplain contains no receptors classified as vulnerable to flooding	Major adverse: Would cause an increase in peak flood level (maximum increase >100mm) to agricultural or other greenfield land either side of the flood mitigation diversion ditch where this meets the River Blackwater.	**Slight adverse:** DMRB LA 104 matrix results in slight/moderate adverse significance of effect. A slight adverse significance of effect has been reported, as the area for which the proposed scheme would cause an increase in flood risk contains no receptors classified as vulnerable to flooding under DMRB LA 113 guidance, and would be owned by National Highways (land would include proposed flood mitigation diversion ditch).
Crossing of Ordinary Watercourse 21A (including flood mitigation works)	Low: Floodplain contains no receptors classified as vulnerable to flooding	Major adverse: Would cause an increase in peak flood level (maximum increase >100mm) to agricultural or other greenfield land upstream of the A12 crossing, where flood mitigation channel and excavated drains are proposed to be located.	**Slight adverse:** DMRB LA 104 matrix results in slight/moderate adverse significance of effect. A slight adverse significance of effect has been reported, as the area for which the proposed scheme would cause an increase in flood risk contains no receptors classified as vulnerable to flooding under DMRB LA 113 guidance and would be within the final footprint of the proposed scheme (land would include proposed flood mitigation channel and excavated drains).

Location of proposed scheme interaction with modelled watercourse	Importance of floodplain[1]	Magnitude of scheme impact[2]	Residual effect[3]
Western crossing of Domsey Brook	Low: Floodplain contains no receptors classified as vulnerable to flooding	Minor beneficial: Would cause a decrease in peak flood level (maximum decrease 10-50mm) to agricultural or other greenfield land upstream of the crossing.	**Neutral**: DMRB LA 104 matrix results in neutral/slight beneficial significance of effect. A neutral beneficial significance of effect has been reported, as the area for which the proposed scheme would cause a reduction in flood risk contains no receptors classified as vulnerable to flooding under DMRB LA 113 guidance and the reduced flood risk is unlikely to impact current use.
Crossing of Ordinary Watercourse 23 (including flood mitigation works)	Low: Floodplain contains no receptors classified as vulnerable to flooding	Minor beneficial: Would cause a decrease in peak flood level (maximum decrease >15mm) to agricultural or other greenfield land (including residential gardens) upstream of the A12.	**Neutral**: DMRB LA 104 matrix results in neutral/slight beneficial significance of effect. A neutral beneficial significance of effect has been reported, as the area for which the proposed scheme would cause a reduction in flood risk contains no receptors classified as vulnerable to flooding under DMRB LA 113 guidance and the reduced flood risk is unlikely to impact current use.

Location of proposed scheme interaction with modelled watercourse	Importance of floodplain[1]	Magnitude of scheme impact[2]	Residual effect[3]
	Low: Floodplain contains no receptors classified as vulnerable to flooding	Major adverse: Would cause an increase in peak flood level (maximum increase >450mm) to agricultural or other greenfield land where flood mitigation works are proposed (flood storage areas).	**Slight adverse:** DMRB LA 104 matrix results in slight/moderate adverse significance of effect. A slight adverse significance of effect has been reported, as the area for which the proposed scheme would cause an increase in flood risk contains no receptors classified as vulnerable to flooding under DMRB LA 113 guidance and would remain within the proposed scheme's permanent land take, would be owned by National Highways and consequently would not impact other parties (land would include proposed flood storage area).
	Low: Floodplain contains no receptors classified as vulnerable to flooding	Major beneficial: Would cause a decrease in peak flood level (maximum decrease >150mm) to agricultural or other greenfield land where flood mitigation works are proposed (flood storage areas).	**Slight beneficial:** DMRB LA 104 matrix results in slight/moderate beneficial significance of effect. A slight beneficial significance of effect has been reported, as the area for which the proposed scheme would cause a reduction in flood risk contains no receptors classified as vulnerable to flooding under DMRB LA 113 guidance and the reduced flood risk is unlikely to impact current use.

Location of proposed scheme interaction with modelled watercourse	Importance of floodplain[1]	Magnitude of scheme impact[2]	Residual effect[3]
Crossing of Ordinary Watercourse 26 (including flood mitigation works)	Low: Floodplain contains no receptors classified as vulnerable to flooding	Major adverse: Would cause an increase in peak flood level (maximum increase >100mm) to agricultural or other greenfield land where flood mitigation works are proposed upstream of the A12 crossing (flood storage area, excavated drains).	**Slight adverse:** DMRB LA 104 matrix results in slight/moderate adverse significance of effect. A slight adverse significance of effect has been reported, as the area for which the proposed scheme would cause an increase in flood risk contains no receptors classified as vulnerable to flooding under DMRB LA 113 guidance and would remain within the proposed scheme's permanent land take, would be owned by National Highways and consequently would not impact other parties (land would include proposed flood storage area, excavated drains).
	High: Floodplain contains residential properties - 'more vulnerable development'	Moderate beneficial: Would cause a decrease in peak flood level (maximum decrease 50-100mm) to land in between the existing and the new A12 (including a 10-50mm decrease in flood levels impacting five residential properties.	**Moderate beneficial:** DMRB LA 104 matrix results in moderate/large beneficial significance of effect. A moderate beneficial significance of effect has been reported, as the area for which the proposed scheme would cause a decrease in flood risk contains residential properties (classed as more vulnerable to flooding under DMRB LA 113 guidance) but does not eliminate flood risk to those properties.

Location of proposed scheme interaction with modelled watercourse	Importance of floodplain[1]	Magnitude of scheme impact[2]	Residual effect[3]
	Low: Floodplain contains no receptors classified as vulnerable to flooding	Major beneficial: Would cause a decrease in peak flood level (maximum decrease >100mm) to Hall Chase local road and nearby area of agricultural or other greenfield land.	**Moderate beneficial:** DMRB LA 104 matrix results in slight/moderate beneficial significance of effect. A moderate beneficial significance of effect has been reported, as the area for which the proposed scheme would cause a reduction in flood risk contains a local road (unclassified in flood risk vulnerability classification table under DMRB LA 113 guidance).
	Low: Floodplain contains no receptors classified as vulnerable to flooding	Major beneficial: Would cause a decrease in peak flood level (maximum decrease >100mm) to an area of agricultural or other greenfield land located south of the Great Eastern Mainline railway line downstream of the A12 crossing.	**Slight beneficial:** DMRB LA 104 matrix results in slight/moderate beneficial significance of effect. A slight beneficial significance of effect has been reported, as the area for which the proposed scheme would cause a decrease in flood risk contains no receptors classified as vulnerable to flooding under DMRB LA 113 guidance.

[1] Receptor importance (of proposed scheme floodplain crossing) has been defined as per Table 3.70 of DMRB LA 113 (Highways England, 2020a) which uses vulnerability of development (defined in the Flood Risk section of the Technical Guidance to the NPPF, 2012) located within the floodplain (in this case the 1% (1 in 100) AEP event plus allowance for climate change has been used) crossed within the study area to define the importance.

[2] Magnitude of effect has been defined as per Table 3.71 of DMRB LA 113. Flood event considered: 1% (1 in 100) AEP event plus allowance for climate change (see FRA in Appendix 14.5 [TR010060/APP/6.3]) for details of climate change uplifts applied during modelling). Where the most significant adverse effects have been identified for more frequent events modelled, these have been included in the table with the return period clearly stated.

[3] Effect significance has been determined based on Table 3.8.1 of DMRB LA 104 (Highways England, 2020d) using the assigned importance of receptor and magnitude of impact, using methodology defined in DMRB LA 113.

Table 14.18 Operational phase flood risk effects (unmodelled impacts)

Location	Potential significance (pre-mitigation)	Mitigation measure to be applied	Significance (post-mitigation)
Available information (Environment Agency RoFSW mapping and resident-provided photographic evidence) indicates that the proposed scheme at Inworth Road could be at risk of flooding from Ordinary Watercourses in the range of 300 – 900mm depth in a 0.1% (1 in 1000) AEP event.	Neutral	Flood storage areas to mitigate flood risk to the road.	**Very large beneficial**
Adjacent to Ordinary Watercourses identified as not requiring hydraulic modelling. Areas of increased flood risk because of extension of existing watercourse crossing infrastructure or installation of new watercourse crossing infrastructure.	Large adverse	Drainage design (see Surface Water Drainage Strategy (Appendix 14.6) and FRA (Appendix 14.5 [TR010060/APP/6.3]) for surface water drainage design criteria).	**Neutral**
Scheme wide – Increased risk of flooding (fluvial, surface water, sewer and drainage infrastructure) due to increase in the rate and volume of runoff caused by an increase in impermeable surfaces.	Large adverse	Drainage design (see Surface Water Drainage Strategy and FRA for surface water drainage design criteria).	**Neutral**
Scheme wide – Culverts have the potential to become blocked with debris and result in increased risk of fluvial flooding.	Large adverse	An assessment for the provision of trash screens would be undertaken on all existing and new culverts in the proposed scheme. Trash screens would be incorporated into the design where this assessment identifies that they would be required.	**Neutral**

Location	Potential significance (pre-mitigation)	Mitigation measure to be applied	Significance (post-mitigation)
Scheme wide – Where the proposed scheme elements (including the road, particularly in cuttings, and other infrastructure) coincide with areas of existing groundwater flood risk, these may lead to an increased risk of groundwater flooding.	Large adverse	To protect flood-sensitive receptors (including the new road) from groundwater flooding, groundwater seepages would be collected by the proposed road drainage system to prevent groundwater reaching the surface. Drainage design (see Surface Water Drainage Strategy (Appendix 14.6) and FRA (Appendix 14.5) for surface water drainage design criteria).	**Neutral**
Scheme wide – Where deep foundations for new overbridges and gantries or sheet piling would be located within areas of existing groundwater flood risk, these would have the potential to form a barrier to groundwater flow, thereby locally increasing the groundwater flood risk up-gradient.	Large adverse	All foundations and below-ground linear structures expected to intercept high groundwater levels would be designed to allow existing groundwater flow paths to function. This would prevent an increase in groundwater flood risk to flood-sensitive receptors elsewhere.	**Neutral**
Scheme wide – Ground compaction as a result of any embankments would be expected to restrict groundwater flow in the areas that coincide with shallow groundwater levels.	Moderate adverse	Embankments would be designed to allow existing groundwater flow paths to function. This would prevent an increase in groundwater flood risk to flood-sensitive receptors elsewhere.	**Neutral**

14.12 Monitoring

Surface water quality and resources

Construction

14.12.1 There are no residual significant effects upon surface water quality which require monitoring. As best practice, surface water quality would be monitored throughout the construction phase of the proposed scheme. Monitoring would be designed to demonstrate compliance with any environmental permits and/or abstraction licences in place. It would also contribute to identifying any detrimental effects on the water environment and to allow any pollution incidents to be identified and remedied. This would also build data on the effectiveness of design and mitigation measures within the drainage strategy to drive improvement in environmental performance for future projects.

14.12.2 A Water Quality Monitoring Plan would be prepared prior to construction by the Principal Contractor covering the pre-construction phase, during construction, and potentially post-construction where considered appropriate.

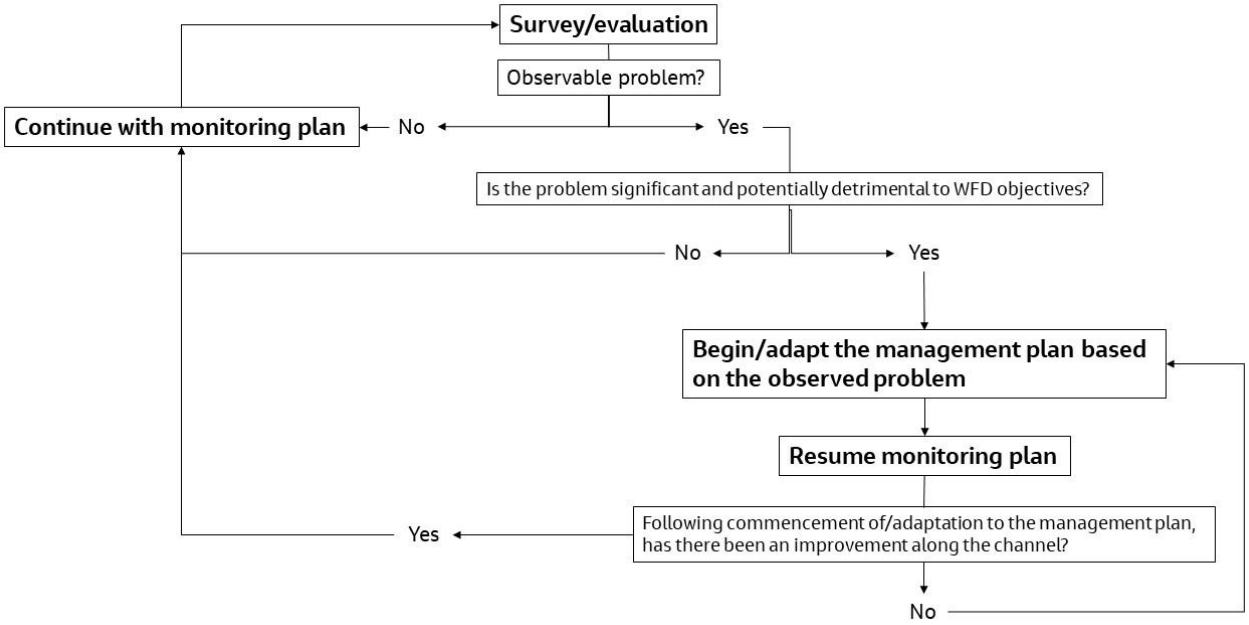
Operation

14.12.3 No monitoring in terms of water quality treatment is proposed during operation of the proposed scheme.

Hydromorphology

14.12.4 Monitoring would be required on Ordinary Watercourse 11 where significant effects could take place at the culvert and at the permanent outfalls to the River Chelmer, River Blackwater, Boreham Brook, River Ter, Domsey Brook and Roman River. It would involve observations of the channel to determine whether bank protection is required. This would be achieved through taking photographs of the affected areas and comparing them with either, images taken from the previous surveys or baseline conditions. If any issues are observed, then the adaptive management plan process in Plate 14.1 would be enacted.

Plate 14.1 Monitoring and adaptive management process



14.12.5 The monitoring would be undertaken by the Principal Contractor in May/June and September, over a period of one year following the completion of construction. This would ensure vegetation is visible but not so well developed that it obscures observations or hinders access. Adaptive management would take place if monitoring concludes that bank protection is required.

Groundwater

Construction

14.12.6 Additional ground investigation would be required to inform the detailed design phase (including detailed drainage development), environmental permitting requirements and to refine the assessments associated with dewatering, settlement, drainage, gas main diversion, sheet piles and flood compensation storage areas. That would include targeted *in situ* permeability/pump testing, groundwater level and quality monitoring for a period of 12 months.

14.12.7 A programme of targeted groundwater monitoring would be undertaken prior to, during and following construction at sensitive receptor locations identified as needing additional mitigation measures as detailed in Section 14.10 of this chapter. This includes long-term groundwater level and surface water flow monitoring around borrow pit I to support detailed assessments on Wet Woodland 7. The Water Balance Compensation strategy for Wet Woodland 7 would determine whether monitoring of boreholes BH2058, 59 and 60 should continue during construction of borrow pit I and up until groundwater has rebounded.

14.12.8 Post-construction NVC monitoring would be undertaken to verify that no significant change in vegetation has taken place during construction at Wet Woodland 7.

14.12.9 Depending on the outcome of the refined groundwater abstraction assessment, this could include monitoring of groundwater levels at four licensed groundwater abstractions (LGA-5, LGA-6, LGA-7 and LGA-17) and groundwater quality at seven licensed (LGA-2, LGA-3, LGA-5, LGA-17, LGA-24, LGA-27 and LGA-33) and two private unlicensed abstractions (PGA-2 and PGA-5) although a further seven locations require additional information on their status, operation and location and also may need further monitoring. A minimum of six months' baseline monitoring would be undertaken in advance of the start of construction. The monitoring would continue during construction and extend for six months post construction.

14.12.10 All groundwater monitoring taking place during construction would relate to likely significant effects should they be identified following refinement of the groundwater abstraction requirements during detailed design.

Operation

14.12.11 Some of the groundwater abstraction monitoring could extend into the first year of the operational phase.

Flood risk

14.12.12 No monitoring would be required during the construction or operational phase as it would be highly unlikely that significant flooding would occur during the construction or defects period.

14.13 Summary

Water quality

14.13.1 After embedded and standard mitigation is applied, the residual effects are **slight adverse** or **neutral**, and therefore the effects of the proposed scheme are not environmentally significant upon surface water quality and water resources. The inclusion of features which would provide water quality treatment where currently there are none, would lead to a betterment compared to the existing situation.

Hydromorphology

14.13.2 Following additional mitigation, as indicated in Section 14.10 of this chapter, it is unlikely that the proposed scheme would pose a significant risk to hydromorphological receptors.

Groundwater

14.13.3 Following mitigation measures detailed in Section 14.10 of this chapter, the residual effects of the proposed scheme on groundwater during both the construction and operational phase are anticipated to be **slight** to **neutral**.

14.13.4 No significant effects are considered likely after additional mitigation measures are implemented.

Flood risk

14.13.5 Including mitigation detailed in Section 14.10 of this chapter, the residual effects of the proposed scheme on flood risk during the construction phase are anticipated to be **neutral** (refer to Section 14.11 and Appendix 14.5 – FRA, for details [TR010060/APP/6.3]).

14.13.6 Including mitigation detailed in Section 14.10 of this chapter, the permanent residual effects of the proposed scheme on flood risk are anticipated to be **slight adverse** to **very large beneficial** (the majority of adverse impacts are to areas within the permanent land take of the proposed scheme) (refer to Section 14.11 of this chapter and Appendix 14.5 [TR010060/APP/6.3], for details).

14.13.7 NNNPS requirements for road drainage and the water environment are outlined in Section 14.4 of this chapter. Regarding flood risk, it is considered that the proposed scheme would be compliant with the NNNPS requirements.

All RDWE matters

14.13.8 A summary of adverse and beneficial significant effects is included in Table 14.19. There are no significant adverse effects as a result of the proposed scheme for the water environment. There are significant beneficial effects with regard to flood risk. As a result, the proposed scheme complies with advice given in the NNNPS.

Table 14.19 Summary of significant residual road drainage and the water environment effects

Description of effect	Mitigation measures	Significance of effect
Construction		
There would be no significant effects to RDWE during construction due to the mitigation measures in place.		
Operation		
Flood risk: Proposed flood mitigation works associated with Ordinary Watercourse 21 result in mitigation of existing flood risk to the existing A12 (‘essential infrastructure’) and to residential properties.	No mitigation measures proposed as effect is beneficial.	Large - Very large beneficial (significant)
Flood risk: Proposed flood mitigation works associated with Ordinary Watercourse 26 result in decreased flood risk (maximum decrease >100mm) to a local road and decreased flood risk (maximum decrease 10-50mm) to residential properties.	No mitigation measures proposed as effect is beneficial.	Moderate beneficial (significant)

Description of effect	Mitigation measures	Significance of effect
Flood risk: Proposed flood storage areas associated with Inworth Road result in mitigation of existing flood risk to the road.	No mitigation measures proposed as effect is beneficial.	Very large beneficial (significant)

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