Lower Thames Crossing

9.89 Responses to the Examining Authority's ExQ1 Appendix F – 10. Road Drainage, Water Environment & Flooding

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1 Introduction

1.1 Introduction

1.1.1 This document has been prepared by the Applicant to set out its responses to the Examining Authority's (ExA's) first round of written questions [PD-029].

1.1.2 These can be found in Tables set out under the following headings:

a. Climate Change and carbon emissions (Found in Appendix A)

b. Consideration of alternatives (Found in Appendix A)

c. Traffic and transportation (Found in Appendix B)

d. Air quality (Found in Appendix C)

e. Geology and soils (Found in Appendix D)

f. Waste and materials (Found in Appendix D)

g. Noise and vibration (Found in Appendix E)

h. Road Drainage, water environment and flooding (Found in Appendix F)

i. Biodiversity (Found in Appendix G)

j. Physical effects of development and operation (Found in Appendix H)

k. Social, economic and land-use considerations (Found in Appendix I)

l. Draft Development Consent Order, planning obligations, agreements and adequacy of security (Found in Appendix J)

m. The acquisition and temporary possession of land and rights (Found in Appendix J)

n. General overarching questions (Found in Appendix J)

2 Responses to the Examining Authority's ExQ1 10

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ExQ1_Q10.1.1	LLFAs Internal Drainage Boards (IDB)	**Consultation** Appendix 14.2 – Water Features Survey Factual Report (1 of 2) [APP-454] paragraph 1.1.1 suggests that the extent of surveys were agreed with the Environment Agency. Were other statutory bodies consulted and if not, why not? What difference would be made to the survey limits if other Flood Risk Management Authorities were consulted? And consequently, what difference if any would be made to proposed development?
		Response: The purpose of the Water Features Survey [**APP-454 and APP-455**] was to identify and record the baseline characteristics of surface water and groundwater features that may be affected by the construction and operational phases of the A122 Lower Thames Crossing (the Project). The survey extents were agreed with the Environment Agency as a key Flood Risk Management Authority and due to their role in granting environmental permits for discharges to the water environment and abstractions from the water environment. Other Flood Risk Management Authorities, namely the Lead Local Flood Authorities, were given an opportunity to comment on the proposed survey extents. No comments were received. In addition, as detailed in Section 1.2 (paragraphs 1.2.2 and 1.2.4) of the Water Features Survey [**APP-454**] report, the RSPB, Natural England, the North Kent Marshes Internal Drainage Board, the Thames and Medway Canal Association, landowners and desk study sources provided data that informed the survey, resulting in a robust characterisation of the baseline water environment over the full area relevant to the proposed development. Therefore, it is unlikely that further consultation with other statutory bodies would have resulted in any changes to the survey limits or to the proposed development.
ExQ1_Q10.2.1	N/A	**Surface Water Flood Risk** Document 6.3 Environmental Statement Appendices Appendix 14.6 - Flood Risk Assessment - Part 6, paragraph 8.2.4, [APP-465] suggests: "Some isolated pockets of surface water flooding within the curtilage of the highway would be lost and some would be partially lost. This may cause a minor redistribution of surface flooding beyond the curtilage of the Project road, but this is not considered to present a significant flood risk. Furthermore, any such redistribution would mostly lie within land for which National Highways would be seeking permanent acquisition." There are similar paragraphs in the sections referring to the other lengths of the

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		proposed highway. Considering the A13 junction at Baker Street in particular, although there is a similar concern wherever embankments or land raising are proposed, there have been instances of unintended consequences where isolated pockets of surface water flooding and/or redistribution of surface flooding has affected third party property. Can the Applicant advise the options that can be considered as being available to allow the detailed design process to deal with the redistribution of surface flooding without compromising existing property or existing drainage systems at the junction and other areas where embankments are to be sited adjacent to existing property?
		Response: This response should be read in conjunction with Drawings 00130, 00131 in Environmental Statement (ES) Appendix 14.6: Flood Risk Assessment - Part 9 Annex A [**APP-469**] and Drawing 00132 in Part 9 Annex B [**APP-470**]; and with due regard to the inherent uncertainties associated with surface water flood mapping. The increase in surface water flood risk due to redistribution of pockets of surface water is considered to be negligible. The micro-catchments of individual pockets of surface water flooding may merge or reduce in size as a result of proposed highway embankments. Where micro-catchments merge, the pocket may increase in area and depth or overspill into another local depression (i.e. generally within land subject to permanent acquisition) but would only represent a negligible increase in surface water flood risk. Pockets of surface water flooding close to the highway embankments would be drained by the highway drainage system (e.g. via embankment toe drains or perimeter drains). Interception of overland surface water flow paths do have the potential to cause an increase in flood risk in third-party land. Instances where surface water flow paths have the potential to impact third-party land are detailed in Tables 8.1 to 8.3 and 10.1 to 10.3 of ES Appendix 14.6: Flood Risk Assessment - Part 6 [**REP1-171**]. Suggested mitigation actions are also detailed in these tables. These mitigation measures will be developed during detailed design in conjunction with the highway drainage design.
ExQ1_Q10.2.2	N/A	**Infiltration Ponds** For all the infiltration basins proposed: - What method has been employed to determine the maximum size of the ponds, their depth and the necessary land take? - Are the ponds intended to be dry ponds or have water in their base to support the project's ecological mitigation? - Should the ponds be expected to be dry, what allowance has been made for the infiltration rates with topsoil and grass / or other surfacing? - If the ponds are to be wet, again, what are their expected infiltration rates?

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		Response: Environmental Statement (ES) Appendix 14.6: Flood Risk Assessment - Part 7 [**APP-466**] sets out the proposed surface water drainage approach for the Project. The drainage design basis for each of the Project catchments is described in Section 2.3, Section 3.3 and Section 4.2. The proposed drainage system has been designed to rapidly remove water from the carriageway and accommodate runoff from the highway and from adjacent (external) catchments, with increased rainfall intensities in accordance with predicted climate change effects, to prevent flooding of the carriageway for the design storm return periods within the various constraints of the Project. With respect to both outfall discharge rates and water quality, the aim of the design is to meet the requirements of all appropriate Design Manual for Roads and Bridges[1] design guidance notes and standards (including CD 522 Drainage of Runoff from Natural Catchments, CG 501 Design of Highway Drainage Systems, CD 532 Vegetated Drainage Systems for Highway Drainage, LA 113 Road Drainage and the Water Environment) and comply with the requirements of the Environment Agency. Due to the predominantly permeable nature of the ground south of the River Thames, there is an absence of natural watercourses as rainfall infiltrates into the chalk subsoils. Existing drainage networks along the A2 within the Project area currently discharge into infiltration basins and it is considered that soakaways/infiltration works well in this locality. Microdrainage modelling was used to determine the required size of the infiltration basins by modelling the incoming flows, with the anticipated outflow based on infiltration rates for a number of design scenarios including a 100-year return period (with an allowance for climate change). Further detailed groundwater modelling of the infiltration basins was carried out to inform the Project's hydrogeological risk assessment in Annex M and N of ES Appendix 14.5: Hydrogeological Risk Assessment (Part 2 of 2) [**APP-459**]. Annex N is a technical note titled "*Infiltration Drainage Hydrogeological Assessment North Portal to A13/A1089/A122 Lower Thames Crossing Junction*" and Annex M is a technical note titled "*Infiltration Basins Detailed Assessment South of the River Thames*". Both technical notes provide details of the site investigation and analytical methodology used to determine infiltration rates, and to confirm the sizing of the infiltration basins. The scenarios considered are presented in Section 5.3 (Annex M) and Section 4.3 (Annex N) and presented below for clarity:

[1] National Highways. Design Manual for Roads and Bridges. https://www.standardsforhighways.co.uk/

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		• Scenario 1: steady state mounding using average drainage infiltration. For this scenario, the average daily precipitation rate (1.78mm/d) (UK Centre for Ecology and Hydrology, 2020) is used to calculate the required infiltration rate for each basin. A runoff coefficient of 0.9 is used for asphalt pavement, hence 10% of precipitation is lost to the likes of interception, evaporation or car carry-off. This is a steady state scenario to assess the potential long-term mounding effects. • Scenario 2: mounding levels after a wet season (180 days). To simulate a wet season, the 90th percentile of daily precipitation (5.8mm/d) is used to calculate the infiltration rate, also assuming a runoff coefficient of 0.9, for a period of 180 consecutive days. • Scenario 3: worst-case drainage infiltration from a 1 in 100-year storm (24 hours infiltration), associated with a 20% increase in peak rainfall intensity due to climate change and a further sensitivity test carried out with a 40% increase in peak rainfall intensity due to climate change. Under the scenario conditions of peak infiltration, mounding is simulated beneath the infiltration basins after 24 hours operation to determine whether the basins would fail and result in groundwater flooding. For the infiltration basin assessed in Annex N, daily precipitation rates relevant to the location of the basin were used. The drainage design strategy for the Project's proposed infiltration basins is set out in paragraphs 2.4.10 to 2.4.16, Part 7 of the Flood Risk Assessment [**APP-466**]. The infiltration basins have been designed to be dry, except during rainfall events and will comprise a vegetated basin with a series of infiltration trenches within the base area. The permeability of the root zone mix should be greater than that of the infiltration medium below, which will ensure the vegetated layer does not inhibit infiltration. The basins have not been designed as part of the Project's ecological strategy and have a primary function to serve the highway drainage network.
ExQ1_Q10.2.3	N/A	**Infiltration Ponds** Overtopping of the infiltration basins has been noted as a residual risk in document 6.3 Environmental Statement Appendices Appendix 14.6 - Flood Risk Assessment - Part 6, [APP-465], however the mitigation suggests that "Overland flow paths would be established to manage any overtopped flows where appropriate [RDWE034]. - What has been considered as being suitable locations for this overland flow to discharge? Can it be confirmed that the discharge route has a likelihood of accepting the flow without detriment to existing land, property and infrastructure? - Have the submitted documents considered the risk of pollution or otherwise adversely affecting groundwater from potential overtopping of infiltration basins?

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		Response: Infiltration basins would be designed to accommodate the runoff generated by the 1 in 100-year storm with a 40% climate change allowance, with an additional remaining freeboard (i.e., space between the top water level and the crest of the basin bunds). There is a residual risk of overtopping, however this is assessed as being very low and would be in response to an exceptional future storm event. To the south of the River Thames, infiltration basins are located in undeveloped areas and away from property or infrastructure, there is only a very low risk that sensitive receptors could be impacted by overtopped flows. At the A13/A1089/A122 Lower Thames Crossing junction, exceedance flows would be captured within the highway boundary. Where exceedance flow paths need to be established, as secured by RDWE034 within the Code of Construction Practice [**REP3-104**], the overtopped flows would be guided towards existing (pre-development) exceedance flow paths. Any civil works required to establish the flow paths would be within the Order Limits but overtopped flows would eventually be discharged to areas where existing exceedance flows naturally gather which may be beyond the Order Limits. The risk of pollution of groundwater (or surface water receptors) during an overtopping event would be negligible due to the very considerable dilution provided for by the huge volumes of rainfall runoff that would generate an overtopping event.
ExQ1_Q10.2.4	N/A	**Infiltration Pond at Park Pale** Construction of a gravity highway drainage network incorporating new infiltration basin (Work No. 1I – as shown on sheet 3 of the works plans [APP-019]) is located to the east of the industrial development on Park Pale. On 6 July 2023 (USI-05), on Route 31: Bowesden Lane to Park Pale Farm it was noted that the proposed location of the pond is on land that is currently at a higher level than the existing highway and as such a gravity system is unlikely to work. Additionally, it is at the extremity of the proposed work areas surrounded by land that is to remain unaffected by the proposed works, Work parcel OSC1, 1I and to the north E3 (Ancient Woodland mitigation). The general fall of the land is high ground towards the North and East towards the A2/M2. The existing highway is the low point in the area. - Can these works be implemented as proposed and, if so, how will they be implemented? - Have the potential effects of the excavation and subsequent rakes of banks been considered fully in the ES and other application documents? - What route would exceedance flows that could exit the pond basin follow and could they place existing or proposed infrastructure at risk?

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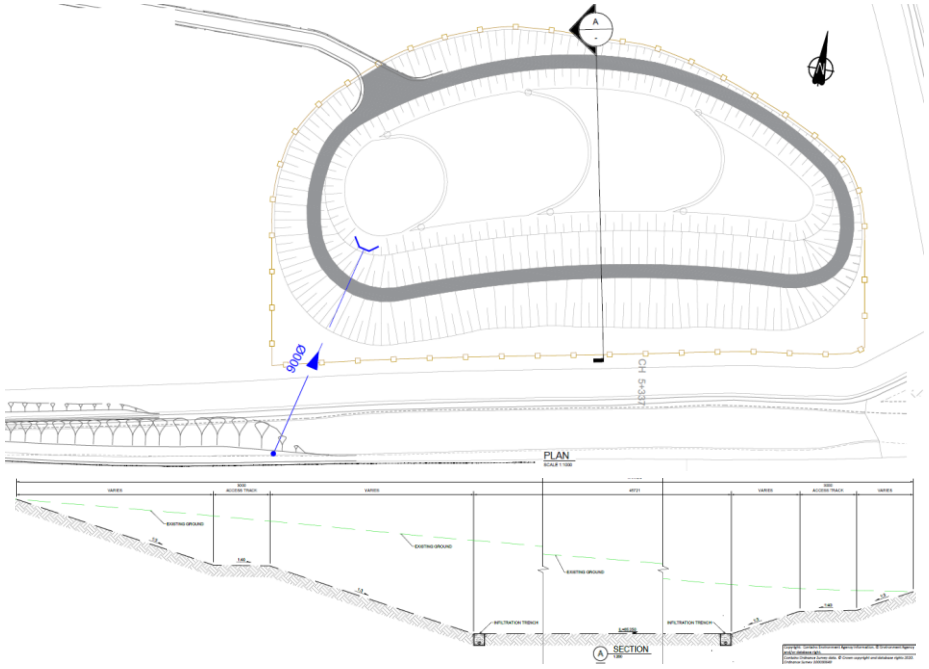
		Response: The infiltration basins have been designed in line with Design Manual for Roads and Bridges (DMRB) standards. The carriageway levels are shown on Engineering Drawings and Sections (Volume C) (A2 M2 and A2 Mainline Plan and Profiles) [**APP-032**] and confirm that the A2 levels fall towards the eastern end. The A2/M2 mainline carriageway has a low point of 70.5m (sheet 3 of A2 Mainline – plan and profiles [**APP-032**]) ordnance datum (AOD), the eastbound link road has a low point of 69.9m AOD (sheet 6 of A2/M2 plan and profiles [**APP-032**]). The proposed invert level to the pond located to the north is at a lower level relative to the highway carriageway at approximately 65.2m AOD, allowing a piped gravity-fed system to be used. It is therefore considered that the proposed approach is feasible and can be accommodated within the Order Limits. **Plate 2.1 Harlex Drainage** 

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		This basin includes the catchment of the A2. The new basin lies within a source protection zone, on the boundary between SPZ2 and SPZ3. As such, pollution control will be important. The basin will include pollution control devices as per DMRB CG 501[2] at the inlet along with a lined sedimentation basin at the inlet to improve water quality ahead of the infiltration area. The infiltration area will include infiltration trenches across the invert to maximise infiltration capacity. A penstock chamber will be provided to enable the drainage system to be shut down in the event of an accidental spillage. Infiltration basins in Catchment EFR-1 would be designed to accommodate the runoff generated by a 1 in 100-year storm with a 40% climate change allowance, with an additional remaining freeboard (i.e., space between the top water level and the crest of the basin bunds). There is a residual risk of overtopping, however this is assessed as being very low and would be in response to an exceptional future storm event. Where exceedance flow paths need to be established, as secured by RDWE034 within the Code of Construction Practice [**REP3-104**], the overtopped flows would be guided towards existing (pre-development) exceedance flow paths. Any civil works required to establish the flow paths would be within the Order Limits but overtopped flows would eventually be discharged to areas where existing exceedance flows naturally gather, which may be beyond the Order Limits.
ExQ1_Q10.2.5	N/A	**Embankments in Recognised Flood Plains** It is common for Flood Defences adjacent to 'Main Rivers', particularly those on flood storage areas to be considered falling under the provisions of the Reservoirs Act 1975. - Has the Applicant considered all proposed embankments that would defend the highway or existing property etc from 'Main River' flooding as being subject to the requirements of the Reservoirs Act 1975? - If not previously considered, what changes would be required to the submitted documents should the appropriate embankments be classified as falling under the provisions of the Reservoirs Act 1975?
		Response: With minor exceptions, embankments that raise the height of roads above the level of the floodplain are exempt from registration under Regulation 3(1)(d) of The Reservoirs Act 1975 (Exemptions, Appeals and Inspections) (England) Regulations 2013. All road embankments proposed by the Applicant in the recognised floodplains of

[2] National Highways (2022). Design Manual for Roads and Bridges, CG 501 Design of highway drainage systems. https://www.standardsforhighways.co.uk/search/6355ee38-413a-4a11-989b-0f33af89c4ed

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		the West Tilbury Main and Mardyke are designed to raise the road alignment to above the level of the floodplain and are not considered to fall under the provisions of the Reservoirs Act 1975. A potential exception to this is the proposed access road off Station Road, located approximately 1km north of the North Portal. During detailed design, an All Reservoirs Panel Engineer will confirm whether the Station Road access road embankment falls under the provisions of the Reservoirs Act 1975. In the event that the access road embankment meets the relevant criteria for registration under the Reservoirs Act 1975, an All Reservoirs Panel Engineer will oversee the design and construction of the access road to ensure that it meets reservoir safety requirements in accordance with the Act, and the inspection, maintenance and monitoring regime would be established to meet the standards of a registered reservoir. No changes would be required to the submitted documents should the Station Road access road embankment be classified as falling under the provisions of the Reservoirs Act 1975. Other Project elements with the potential to fall under the provisions of the Reservoirs Act 1975 include: • The proposed bund included within the flood alleviation design in the Mardyke floodplain. This is described in paragraph 11.4.9 of Environmental Statement (ES) Appendix 14.6: Flood Risk Assessment - Part 6 [**REP1-171**], secured through Project commitment RDWE039 in ES Appendix 2.2: Code of Construction Practice [**REP3-104**] and shown on Drawing No. 00181 of ES Appendix 14.6: Flood Risk Assessment - Part 9 - Annex C [**APP-471**]. The Applicant considers that the proposed bund does not fall under the provisions of the Reservoirs Act 1975 as rather than retaining flood water, this bund is designed to prevent the formation of a new flow path as a result of the Mardyke ecological mitigation works and will maintain the local flow pattern between Golden Bridge Sewer and the Mardyke. This is confirmed in paragraph 11.4.9 [**REP1-171**]. • Subject to detailed design, the proposed Tilbury flood compensation area may meet the requirement for registration as a “large raised reservoir” as defined in the Reservoirs Act 1975, as it may be capable of holding more than the relevant threshold volume of water above the surrounding area ground levels. During detailed design, should the flood compensation area fall under the provisions of the Reservoirs Act 1975, an All Reservoirs Panel Engineer will oversee the design and construction of the Tilbury flood compensation area, to ensure that it meets reservoir safety requirements in accordance with the Act. In the event that the flood compensation area meets the criteria for the Reservoirs Act 1975, the inspection, maintenance and monitoring regime would be established to meet the standards of a registered reservoir. Therefore, no changes would be required to the submitted documents should the Tilbury Main flood compensation area be classified as falling under the provisions of the Reservoirs Act 1975.

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ExQ1_Q10.2.6	N/A	**Embankments in Recognised Flood Plains** It is noted that it is proposed to establish a pre-construction baseline for the Main River Defences adjacent to the River Thames while monitoring them during the construction period and for a period of at least two years after completion of the works to construct the tunnel. - What is the level of expected ground movement, and the depth by which the flood embankments are expected to drop? - How quickly are the embankments to be reinstated? - Has the pre-raising of the embankments been considered, and if not, what could be the effect on the proposed embankment designs? - Do any effects in terms of risks to people or property arise from this consideration that have not already been documented in the ES? - Does the Environment Agency have requirements with respect to reinstatement timeframes?
		Response: *What is the level of expected ground movement, and the depth by which the flood embankments are expected to drop?* The level of ground movement and consequent drop in the depth of the flood embankments is expected to be insignificant. This is due to commitment RDWE007, secured in Environmental Statement Appendix 2.2: Code of Construction Practice, First Iteration of Environmental Management Plan (CoCP) [**REP3-104**], to adopt good tunnelling practice such as continuous working, erecting linings immediately after excavation, grouting, management of tunnel face pressures and the measurement of excavated material quantities. *How quickly are the embankments to be reinstated?* The Applicant is committed to monitoring the flood defences, secured through commitments RDWE007 and GS003 within the CoCP [**REP3-104**]. The monitoring methodology would be agreed with the Environment Agency, unless otherwise agreed with the Secretary of State, and would continue until the annual rate of settlement is less than a rate identified in agreement with the Environment Agency, unless otherwise agreed with the Secretary of State. If the secured monitoring were to detect any effects on the integrity due to ground movement of the assets during construction of the Project, remedial works to reinstate the flood defences would be designed and undertaken as soon as is reasonably practicable, in consultation with the Environment Agency. *Has the pre-raising of the embankments been considered, and if not, what could be the effect on the proposed embankment designs? Do any effects in terms of risks to people or property arise from this consideration that*

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		have not already been documented in the ES? Does the Environment Agency have requirements with respect to reinstatement timeframes? The pre-raising of the flood defences has been considered. At this stage of design it is not thought to be necessary, and the Environment Agency has not requested the pre-raising of flood defences. The Contractor would undertake a detailed ground movement assessment during detailed design as part of the continued process for managing ground engineering risks in line with commitment GS003 within the CoCP [**REP3-104**]. However, given the measures secured via commitment RDWE007 to reduce ground movement during tunnelling and the consequent minor expected level of change, coupled with the monitoring proposed, it is considered that there is a low risk of pre-raising of the flood embankments being necessary. As confirmed by item 2.1.66 RRE in the Statement of Common Ground between the Applicant and the Environment Agency [**REP1-058**], the Environment Agency has now confirmed that they are satisfied with commitment RDWE007 'Protection of flood defences from ground movement'. During the Applicant's discussions with the Environment Agency on this matter, the Environment Agency has not stipulated reinstatement timeframes.
ExQ1_Q10.2.7	Environment Agency	**Embankments in Recognised Flood Plains** Which if any proposed embankments are likely, in your view, to require to be registered as a reservoir or be of such a nature that they should be maintained in such a manner required of impounding reservoirs etc?
		Response: The Applicant has provided a response to ExQ1_Q10.2.5.
ExQ1_Q10.2.8	N/A	**Hydraulic Models?** Appendix 14.6 - Flood Risk Assessment - Part 10 [APP-477] suggests that there are models for specific areas of the project, namely the designated "Main Rivers" of Mardyke and West Tilbury Main. It is inferred that modelling has been undertaken for "Main Rivers" only. - Have Hydraulic Models been produced for Ordinary Watercourse catchments?
		Response: Hydraulic models have been developed to aid understanding of flood risk to the Project and arising from the Project. Modelling has been undertaken on a risk basis, with a focus on areas that are at high risk of flooding from rivers, namely the Mardyke and the West Tilbury Main and/or the tidal Thames, guided by the Environment Agency flood map.

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		Modelling of ordinary watercourse catchments has not been undertaken. This is because these watercourses drain much smaller catchments, support lower flows and have much less extensive floodplains. The Project interacts with ordinary watercourses via crossings over relatively short reaches and modelling assessment of ordinary watercourse crossings was not a requirement of the relevant Lead Local Flood Authorities. A commitment is secured in ES Appendix 2.2: Code of Construction Practice [**REP3-104**]. Commitment RDWE013 states that new culverts would be sized to maintain the current land drainage regime.
ExQ1_Q10.2.9	N/A	**Hydraulic Models** Appendix 14.6 - Flood Risk Assessment - Part 10 [APP-477] paragraph 4.1.2 suggests that there are no main rivers or ordinary watercourses in Catchment EFR-1. From the information provided it suggests that the adjacent land appears to have watercourses. There are also ponds within the wooded area. - Have the potential effects for these water bodies been assessed and what effect on the proposals and the mitigation measures could there be if the effect could be detrimental? - How will the proposed project effect watercourses and the ability for future maintenance?
		Response: Surface watercourses and water bodies within the Order Limits in addition to land within 500m of the Order Limits have been recorded within the Water Features Survey Factual Report [**APP-454**] which was compiled through a combination of desk study and site surveys. The report includes information to characterise the ordinary watercourses and ponds on land adjacent to Catchment EFR-1, which are illustrated in Drawing 50149 on sheet 2. The potential for effects on these waterbodies were subsequently assessed in ES Chapter 14: Road Drainage and the Water Environment [**APP-152**] (paragraphs 14.6.23, 14.6.28, 14.6.56, 14.6.83, 14.6.89 and 14.6.101) which concludes that there is no potential for likely significant detrimental effects on these receptors. Access to watercourses for future maintenance by the relevant flood risk management authority/landowner is secured through a specific commitment (S12.05) within the Design Principles [**REP3-110**] with regard to main rivers and by the protective provisions for drainage authorities described in Schedule 14, Part 3 of the draft DCO [**REP3-077**].
ExQ1_Q10.2.10	N/A	**Overland Flow** Paragraph 8.3.5 of Appendix 14.6 - Flood Risk Assessment - Part 6 [APP-465] suggests that there is no requirement to provide flood protection measures in Catchment EFR-1. - Is there any concern about interrupting surface flow or dealing with exceedance flows?

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		Response: As described in paragraph 6.4.1 of Environmental Statement Appendix 14.6: Flood Risk Assessment - Part 6 [REP1-171] flood protection in the context of the Project comprises measures necessary to protect the development during flood events, examples including flood bunds or flood walls. No flood protection measures are necessary in Catchment EFR-1 due to the low baseline risk of flooding from all sources. Drawing 00130 in Appendix 14.6: Flood Risk Assessment - Part 9 [APP-469] shows existing surface water flow paths in catchment EFR-1. The drawing shows three key flow routes with potential to be interrupted, each of which is discussed in Tables 8.1 to 8.3 of Appendix 14.6 - Flood Risk Assessment - Part 6 [REP1-171]. The tables include details of the proposed risk management strategies and mitigation and concludes that with these measures in place there would be no offsite impact on surface water flooding. Infiltration basins in Catchment EFR-1 would be designed to accommodate the runoff generated in a 1 in 100-year storm with a 40% climate change allowance and a freeboard (additional space between the top water level and the crest of the basin bunds) of 300mm. There is a residual risk of overtopping, however this is assessed as being very low and would be in response to an exceptional future storm event. As the infiltration basins would be located in undeveloped areas and away from property or infrastructure, there is only a very low risk that sensitive receptors could be impacted by overtopped flows. Where exceedance flow paths need to be established, the overtopped flows would be guided towards existing (pre-development) exceedance flow paths. Any civil works required to establish the flows paths would be within the Order Limits but overtopped flows would eventually be discharged to areas where existing exceedance flows naturally gather, which may be beyond the Order Limits.
ExQ1_Q10.2.11	N/A	**Overland Flow** Paragraph 9.2.17 of Appendix 14.6 - Flood Risk Assessment - Part 6 [APP-465] suggests that flow paths can be provided by culverting. Culverting can limit capacity in relation to overland flow. - What modelling and design assumptions have been adopted in relation to afflux and how has this been minimised? - To what degree has exceedance flow management been considered within the current Rochdale Envelope?
		Response: Paragraph 9.2.17 of Environmental Statement Appendix 14.6: Flood Risk Assessment – Part 6 [REP1-171] describes that the main overland flow paths in Catchment EFR-2 closely follow watercourse alignments and states that where these watercourses are crossed by the Project, culverts under the highway would be provided.

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		These culverts would allow continuity of stream flow, and consequently overland flow, which is limited in extent to the watercourse corridors. Culverts will be designed in accordance with commitment RDWE013, within ES Appendix 2.2: Code of Construction Practice [REP3-104]. This commitment states that new culverts would be sized to maintain the current land drainage regime, including in-channel stream flow and any overland flow associated with out of bank flooding. This demonstrates consideration of exceedance flow path management and the Applicant confirms that these flow paths can be managed within the Order Limits and Rochdale Envelope. Where necessary, the detailed design of culverts would be supported by modelling to ensure compliance with this commitment. This would be confirmed in consultation with the relevant flood risk management authorities.
ExQ1_Q10.2.12	N/A	**Overland Flow** In paragraph 9.2.18 of Appendix 14.6 - Flood Risk Assessment - Part 6 [APP-465], it is suggested that on at least one occasion there will be loss of a flow path. It suggests that part of the flow path catchment will be covered by the project road. What is likely to happen within the rest of the catchment? Could the project road act as a dam on the exiting flow path line? The degree to which the road will operate in this manner will be determined by its location in the surface water overland flow catchment. Water is likely to follow its own route to try to circumnavigate the dam. This could change the location of any offsite surface water flood risk and/ or give rise to afflux in areas of existing surface water flood risk. - Have these possibilities been considered? - If so, how have they been managed? - If not, will these issues require any changes to project design?
		Response: For surface water drainage purposes, drainage catchments would comprise the Project road and any other paved and/or unpaved surface that falls towards it; see paragraph 3.3.1 of Environmental Statement (ES) Appendix 14.6: Flood Risk Assessment Part 7 [APP-466]. Surface water draining to the part of the overland flow path lost to the Project within catchment EFR-2 that is referred to in paragraph 9.2.18 of ES Appendix 14.6: Flood Risk Assessment Part 6 [REP1-171] would therefore be incorporated into a highway drainage catchment, and managed as part of the highway drainage network. The alignment of the downstream part of the overland flow path would be unaffected, but as the catchment area would be reduced, the flow running along the flow path would be reduced.

PINS ID	External Stakeholder (where applicable)	Question / Response
		The risks identified have been assessed and it has been concluded that the Project road would not act as a dam because any surface water draining towards it would be collected by the proposed highway drainage network as presented on the Drainage Plans Volume C (sheets 21 to 49) [**REP3-067**].
ExQ1_Q10.3.1	Water Companies (Anglian Water Services, Northumbrian Water Limited (operating as Essex & Suffolk Water))	**Foul Water Systems** It is noted that connections to existing foul sewer systems will be required for some works such as the Tunnel Services Buildings, furthermore, being a rural area there may also be septic tanks or other small package sewage treatment plants and discharge systems etc that may be disturbed by the proposed works. - Has the appropriate Water Company accepted that the buildings can be accommodated into the existing foul water sewer system, or is it envisaged that other methods of servicing these buildings and other works will be required? If other methods are envisaged, what are they? - What is the proposed method of dealing with any septic tanks and/or package treatment works that may be encountered as part of the proposed works?
		Response: As communicated within Environmental Statement (ES) Chapter 14: Road Drainage and the Water Environment [**APP-152**] at Table 14.1 'Stakeholder engagement', the Applicant has liaised with Southern Water with respect to the Southern Tunnel Services Building (Work No 3C(vi)) and those temporary connections required for compounds south of the river, and Anglian Water with respect to the Northern Tunnel Services Building (Work No 5A(v)) and those temporary connections required for compounds north of the river, in respect of their duties as sewerage undertakers and the Applicant's desire to connect to those networks. Both undertakers have undertaken assessments confirming, at the point they were undertaken, that the existing foul water sewer system has the capacity to support the works and that the Project would be permitted to connect to the public sewerage network (for temporary and permanent provisions). The envisaged demand of the Project has not changed since these assessments were undertaken, but the Applicant acknowledges other influences (network management, other developments) may amend the outcome of those assessments, therefore the Applicant will have to undertake them again in advance of the works being consented at the detailed design stage (in accordance with Requirement 8 of Schedule 2 of the draft Development Consent Order [**REP3-077**]). At the detailed design stage, the Applicant will develop a design and then construct all of the required drainage infrastructure to make the agreed point of connection to the existing network in accordance with the requirements of the sewerage undertaker. The foul water sewer system will be developed in accordance with

PINS ID	External Stakeholder (where applicable)	Question / Response
		Requirement 3 (Detailed Design) and Requirement 8 (Surface and foul water drainage) of Schedule 2 of the Order; and constructed under the provisions of Schedule 1, Ancillary Works (provision (g)) of the Order [**REP3-077**]. The Applicant believes the installation of septic tanks and package treatment plants, albeit a viable solution, would be proposed as a last resort due to associated operation and maintenance challenges versus a typical lateral drain solution. Any existing septic tanks or package treatment works that may be encountered during the development of the design will be assessed and managed in line with the requirements set out in ES Appendix 2.2: Code of Construction Practice, Section 4.5 - Protection of existing infrastructure and buildings [**REP3-104**]: "*4.5.1 Powers related to the protection of existing infrastructure and buildings are included in the DCO.* *4.5.2 EMP2 will require the Contractors to take measures, including the carrying out of surveys, investigations, obtaining consents and agreements, to protect existing buildings and infrastructure and engage with the appropriate Statutory Undertakers and stakeholders. The Contractors will undertake the design and implementation of any repairs, strengthening, modifications (temporary or permanent) required*." The Project shall consult with Anglian Water Services Limited, Thames Water Limited and Southern Water Limited, the sewerage undertakers, in accordance with those Protective Provisions contained at Schedule 14, Part 1 for the protection of electricity, gas, water and sewerage undertakers [**REP3-077**] in those instances that the apparatus forms part of their network.
ExQ1_Q10.4.1	Essex & Suffolk Water	**Water Supply** It is noted that there is a draft agreement between the Water Company and the Applicant in relation to the supply of water for five years from commencement or 31 December 2031 whichever is the earlier. What are the possible consequences if water is required after the deadline noted and construction works are not completed? Is the quality of the water from the Linford Well adequate for use in the tunnel boring machines without treatment? If not, what treatment facilities will be required, what waste will be produced and how will that waste be managed? The Applicant should also set out how this has been assessed.
		Response: The draft agreement expires on the earlier of either five years from commissioning or the date 31 December 2031. The Applicant believes the construction of the tunnels, which uses water supplied from the Linford Well,

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		will be completed in advance of 31 December 2031. In the unlikely event that the works overrun, and, if an extended agreement could not be agreed for the supply from the Linford Well, the proposed alternative would be to utilise the potable water supply provision from the Tilbury ring main, known as the Gun Hill supply (Work No MU29). This would be at an increased cost to the Project and would be combined with the range of water recycling provisions such as rainwater harvesting already implemented on the site. The water that will be taken from the Linford Well is classed as raw water. This water is of adequate quality for the tunnel boring machine (TBM) needs and will not require any further treatment. Due to no treatment of the incoming raw water being necessary for this use, no waste will be produced and, therefore, no assessment of such works is included within the Application. The slurry treatment plant and TBM slurry circuit form a generally closed system with no wastewater generated. At times, a small fraction becomes unsuitable for recirculation and is discharged to waste. Treatment prior to discharge would be through filter presses within the slurry treatment plant and if necessary to meet suspended solids limits, by tertiary sand filter. All proposals and methods in this regard would be subject to permitting by the Environment Agency. The potential effects of the abstraction of groundwater from the Linford borehole on groundwater levels, flows and quality has been assessed within Environmental Statement Appendix 14.5: Hydrogeological Risk Assessment [**APP-458 and APP-459**], whilst the potential effects on the River Thames, which would receive treated discharge waters, has been assessed in Environmental Statement Appendix 14.7: Water Framework Directive [**APP-478**]. The assessments conclude that no significant effects would arise from these activities given the Applicant's commitments included within the Code of Construction Practice [**REP3-104**]: • RDWE003 which states that extraction rates would be agreed with Northumbrian Water prior to commencement of main tunnelling works and the supply of groundwater would be within the limits of the groundwater abstraction licence • RDWE023 which sets out that waste waters would be discharged under condition of an Environment Permit, in compliance with the Environmental Permitting (England and Wales) Regulations 2016 • RDWE028 which confirms that the design of the temporary drainage outfall would be in compliance with measures agreed with Marine Management Organisation as detailed in the Deemed Marine Licence (DCO Schedule 15)

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ExQ1_Q10.4.2	N/A	**Maintenance of Drainage Works** The Applicant is requested to confirm that all watercourses, drains, sewers and other drainage and sewerage infrastructure within the construction sites, and those areas that are to be worked upon as mitigation areas, shall be the responsibility of the Contractor and/or the Highway Authority during the construction/operational period and returned to the appropriate authority and/or owner once the Construction/operational period is completed? Please list any specific sites where the above is not the situation alongside a description of the maintenance responsibilities and how these are actioned, and the reasoning for the position. Where mitigation works are proposed, such as tree planting or habitat construction, what allowances are being placed within the detailed design briefs etc as allowances for ordinary watercourse maintenance to occur? The Design Principles document [APP-516] commits to a bankside access track being incorporated into the design of the crossings on designated 'Main Rivers' only. (paragraph 14.5.9(a))
		Response: During the period of temporary possession, the Contractor will take on the responsibility of maintaining the land, including watercourses and drainage infrastructure within the parcel of land subject to temporary control, in accordance with the provisions of Part 3 of Schedule 14 to the draft DCO [**REP3-077**]. This sets out protective provisions for drainage authorities, including provision for maintenance of watercourses during the construction phase. The management of the maintenance of drainage infrastructure and watercourses will form part of the construction phase drainage plan. The requirement for the Contractor to develop a construction phase drainage plan is secured by commitment RDWE006 within Appendix 2.2: Code of Construction Practice, First Iteration of Environmental Management Plan [**REP3-104**]. See extract below: '*The Contractor shall develop a construction phase drainage plan. The plan shall demonstrate how the Contractor would manage surface water runoff across the worksite, including details of how offsite impacts would be prevented.* *The surface water drainage design for temporary works shall include climate change allowances up to 2030 in accordance with Flood risk assessments: climate change allowances (Environment Agency, 2022).* *Work site drainage systems would incorporate pollution control systems designed in line with Control of Water Pollution from Construction Sites C532 (CIRIA, 2001) or as agreed with the Secretary of State. Surface*

PINS ID	External Stakeholder (where applicable)	Question / Response
		watercourses and waterbodies (as identified in Table 14.9 of ES Chapter 14 (Application Document 6.1)) near work sites would be regularly inspected for signs of siltation or other forms of pollution in line with CIRIA C741 guidance (CIRIA, 2015) and pumped groundwater, process effluents and construction site runoff would be tested to ensure compliance with discharge consent requirements. *Rainfall runoff from areas where there is a risk of contamination would be managed using temporary drainage systems and would be subject to treatment prior to discharge.* *Rainfall runoff from areas of low contamination risk would be captured and reused where reasonably practicably to reduce consumptive water use (e.g. to supply wheel wash facilities or for dust suppression).* *The Contractor shall consult with the Environment Agency on any proposed work site discharge to ground in Source Protection Zone 1 and Source Protection Zone 2.*' Following completion of the specified work (i,e, a work that engages land drainage assets), the Contractor would be responsible for maintenance of land drainage during the 12-month post-completion maintenance period in line with the terms of protective provisions set out in the draft DCO [**REP3-077**] under Schedule 14 Part 3. The responsibility for maintaining the infrastructure within the highway's boundary will be handed over to the relevant highway authority. For instance, the strategic road network will fall under the management of the Applicant, while the oversight of the local road network will be with the appropriate local highway authority. The responsibility for this maintenance is secured under Article 10 of the draft DCO [**REP3-077**], as supplemented by the protective provisions for local highway authorities being included in the dDCO submitted at Deadline 4. With regard to Project areas situated beyond the operational highways boundary, notably landscaping, their maintenance will be in accordance with the requirements outlined in the Landscape and Ecology Management Plan (LEMP) [**REP3-106**]. This requirement has been established through a requirement specified in Schedule 2 of the Development Consent Order (DCO) (Requirement 5) [**REP3-077**]. This outline Landscape and Ecology Management Plan (oLEMP) [**REP3-106**] describes the proposed management of the landscape and ecological elements of the Project. The oLEMP sets out the requirements for the development of a LEMP. It outlines the proposed management and monitoring of the parcels of land that perform landscape and ecological mitigation functions, to mitigate Project impacts. As set out in paragraph 4.1.7 of the oLEMP, land parcels outside of the highway operational boundary may be managed by agreement with third-party stakeholders or adjacent landowners for the long-term management of the habitats and landscape created within. Any agreement would not remove the Applicant's responsibility under the oLEMP, as secured by Requirement 5 of the DCO. The timing of land handover would depend on the management capabilities of the

PINS ID	External Stakeholder (where applicable)	Question / Response
		identified partner organisation (e.g. third-party stakeholder or adjacent landowner). The Applicant will retain the ultimate responsibility for the management and maintenance of all land parcels identified in the oLEMP. Sections 5, 6 and 7 of the oLEMP describe the management area for each parcel of land, and the outline management requirements for each area. In relation to access to main rivers during operation, allowances have been secured within the application to enable the future maintenance of watercourses. Design Principle clause S12.05 [**REP3-110**] secures that where the Project crosses the statutory main rivers Mardyke, Orsett Fen Sewer and Golden Bridge Sewer to facilitate access by the Environment Agency to these watercourses to undertake maintenance activities, a bankside access track shall be incorporated into the design of the crossings, the width of which would be subject to consultation with the Environment Agency. In relation to the access and maintenance of ordinary watercourses during the operational phase, the draft DCO [**REP3-077**] under Schedule 14 Part 3, includes protective provisions for drainage authorities, including provision for enabling access for the maintenance of watercourses.
ExQ1_Q10.4.3	N/A	**Calculation of Flows and Volumes** It is suggested that the outline calculation of flows and volumes have been undertaken utilising indices and/or methodology that have recently been updated. The Applicant should confirm that the detailed design process will include the updating of these indices etc and the use of appropriate, up-to-date, software and processes. If the outline calculations have used, for example, different rates of increase on the different storm events than are now expected, or move from Flood Estimation Handbook (FEH) to Revitalised Flood Hydrograph model (ReFH) what would be the changes required to the submission to allow for the worst-case scenario? In low-lying land, for short duration storms in particular, it has been found that the worst-case scenario for small catchments can be found utilising Flood Studies Report (FSR) rainfall data. Would the use of this have any consequences to the submitted proposals? In Appendix 14.6 – Flood Risk Assessment - Part 5 [APP 464], paragraph 4.1.3 confirms "3 FEH delineated catchment boundaries are not reliable for small flat catchments, due to the resolution of the FEH national Digital Terrain Model." - Was use of the light detection and ranging process (LiDAR) the only method of checking the boundaries and if not, what other methods were employed?
		Response: The Applicant acknowledges that there have been updates to software versions and software tools since completion of the hydrology and hydraulic modelling that informs the DCO Flood Risk Assessment (FRA). The Applicant has engaged frequently and in detail with the Environment Agency during preparation of the FRA and

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		this engagement has continued since submission of the Application. The Environment Agency has not raised this matter as a concern, nor requested updates to the flood models (other than to apply the most up to date climate change allowances). During the detailed design stage, it is expected that should any flood modelling need to be updated, these assessments would be undertaken in accordance with a methodology agreed with relevant stakeholders (for example the Environment Agency and Lead Local Flood Authorities). From experience of the comparative performances of the latest versions and those superseded, it is considered very unlikely that there would be any meaningful change to the outline calculations and adopted flood flows/catchment runoff rates and it is considered that any changes required to the submission would be inconsequential. For example, the compensation flood storage areas proposed, in catchments EFR-2, EFR-4 and EFR-5 (as defined in Table 2.1 of Environmental Statement Appendix 14.6: Flood Risk Assessment - Part 1 [**APP-460**]) would not be affected, as land set aside within the Order Limits for provision of compensation flood storage is larger than the land needed to provide the required volumes of compensation. This approach has been adopted, and agreed with the Environment Agency, to allow the Contractors flexibility in configuring the compensation areas and provides for a margin of safety to accommodate any changes at detailed design when later methods are applied. When defining catchment boundaries, in addition to LiDAR, site visit observations, Ordnance Survey mapping data and data defining the locations of flood defences were used to check the Flood Estimation Handbook[3] catchment boundaries.
ExQ1_Q10.4.4	N/A	**Indirect effects** In paragraph 2.3.6 in document 6.3 Appendix 14.5 – Hydrogeological Risk Assessment [APP-326], it suggests that "Watercourses or surface water bodies that have an impermeable or low permeability base and sides have a barrier to groundwater inflow …" and that some ponds are similarly lined. It continues to conclude that the bodies will not be directly affected by the project, primarily through the influence of changes to the ground water regime, however has consideration of indirect effects been made? Could piling or other works that cause vibration have effects within the red line boundary and if so what effect could these effects have on the submitted documents?

[3] UK Centre for Ecology & Hydrology. Flood Estimation Handbook and Flood Studies Report. https://www.ceh.ac.uk/services/flood-estimation-handbook

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		Response: ES Appendix 12.4: Construction Noise and Vibration Assessment [**REP1-169**] discusses vibration. It is not considered that piling, tunnelling activities or any other vibration-generating construction works would damage the base or banks of adjacent watercourses or surface water bodies. The works would result in vibration levels that would be mostly unmeasurable and lower than the most demanding criteria for effects of vibration on structures, and as such would not result in damage at these features. In addition, unlike a structure above the ground, the base of a watercourse, or natural surface water body, is contained and surrounded by material that would reduce or eliminate any potential damage from vibration. There are therefore no updates required to any submitted documents.
ExQ1_Q10.4.5	Environment Agency Lead Local Flood Authorities (LLFA)	**Site Information** In document 6.3 Appendix 14.5 – Hydrogeological Risk Assessment [APP-326] (paragraph 3.6.16), it suggests that watercourse flow could be seasonal. Descriptions are not clear as to the results of the investigation. - Is this flow into ground observed or assumed? - Could it have gone anywhere else? - Could it be weather dependent and/or reactive to ground water levels? Additionally, within the submitted plans, 6.2 Environmental Statement - Figure 14.1 - Surface Water Receptors and Resources [APP-322], there are a number of 'ordinary watercourses' delineated which are isolated and connect to nothing. - Where do these watercourses discharge? - What effect could interference with these watercourses have on the ground water and biodiversity of the area? - What measures are being proposed to protect these watercourses and have these measures accommodated within the submission or what amendments will be required? In Appendix 14.2 - Water Features Survey Factual Report (2 of 2) [APP-455], it suggests in Figure 2 that the southern Ditch has "….Heavy vegetation etc…and discharge route could not be determined. Experience suggests that ditches not normally maintained from April to July or longer, dependent on a number of options. Is the provision of regular maintenance on these ordinary watercourses etc in this location considered to be particular important? It was suggested that there was no ditch in the location. Was there culverts or other discharge arrangements? For areas where maintenance operations are not clear from the Water Features Survey, what is being proposed, particularly in areas that are proposed for biodiversity or Nitrogen deficiency mitigation? Who is expected to undertake such maintenance works both during the construction phase and during the operational phase? How has this lack of understanding been accommodated in the analysis undertaken for the submission particularly in relation to the influence on biodiversity and/or flood risk? What effect would this have on the submission if not previously considered?

PINS ID	External Stakeholder (where applicable)	Question / Response
		Response: Environmental Statement (ES) Appendix 14.5: Hydrogeological Risk Assessment [**APP-458**], paragraph 3.6.16 refers to the ordinary watercourses (ditches) that flow within land belonging to Manor Farm, including from the Hall Farm moat ponds. Several site visits were conducted between October 2021 and May 2022 to survey the water features. Observations confirmed that typically the network was dry and if flow was observed it then disappeared into the ground after a short distance. There was no strong correlation between weather and observed flow conditions. The length of ditch is over 500m from the pond to the culvert which connects the ditch to the west side of the M25. This ditch network will be diverted as part of the Project (Drainage Plans Volume C (sheet 42) **[**REP3-067]). The isolated ordinary watercourses delineated in ES Figure 14.1: Surface Water Receptors and Resources [**APP-322**], would connect to the wider watercourse network via culvert or flow into ponds which are not depicted on the figure. Any watercourse that falls within the study area (as defined in Section 2 of ES Appendix 14.2: Water Features Survey Factual Report [**APP-454**]) has been assessed for potential effects directly on the water feature as well as any associated effects on the groundwater regime or ecological receptors. Specifically, Annex P of the Hydrogeological Risk Assessment [**APP-459**] provides an assessment of groundwater dependent terrestrial ecosystems. In terms of measures to protect the watercourses at the A122 Lower Thames Crossing/M25 junction, the Project commits to groundwater monitoring (REAC Ref. RDWE045 in ES Appendix 2.2: Code of Construction Practice [**REP3-104**]). The purpose of this is to confirm the effectiveness of the mitigation described for the A122 Lower Thames Crossing/M25 junction cutting, shown in REAC Ref. RDWE038 [**REP3-104**]. RDWE038 states that during detailed design, having regard for ground investigation data and monitoring (groundwater levels, surface water levels and, where feasible, flows), the need for measures to reduce groundwater drawdown beyond the M25 cutting, for example through the implementation of seepage control, would be assessed and, if confirmed to be necessary, the detail of such measures would be agreed by the Secretary of State following consultation with the Environment Agency and the London Borough of Havering. This is to ensure no significant adverse impact to the surrounding watercourses, surface water bodies and associated terrestrial biodiversity including sites of interest for nature conservation (SINC) at Hall Farm moat; St Mary Magdalene Churchyard SINC; and Thames Chase Forest Centre (including the pond called Hobbs Hole). Therefore, there is no change required to the DCO application documents regarding protection of watercourses for the questioned A122 Lower Thames Crossing/M25 junction Manor Farm area.

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		Regular maintenance (e.g. vegetation clearance) of ordinary watercourses comprising ditches on land belonging to Manor Farm is the responsibility of the owner of the land adjacent to these watercourses. In response to seasonal weather events, seasonally overgrown ditches could result in overtopping of the ditches and localised waterlogging/shallow flooding of adjacent land that is mostly agricultural fields. Maintenance of the downstream culvert beneath the London, Tilbury and Southend railway and the culvert beneath the M25 embankment are the responsibility of Network Rail and the Applicant respectively. This will continue during the construction phase and operational phase of the Project. The outline Landscape and Ecology Management Plan (oLEMP) [**REP3-106**] provides information on the proposed management and maintenance operations of the landscape and ecological elements of the Project, inclusive of watercourses. This would include areas that are proposed for biodiversity and nitrogen deposition compensation. Details of the proposed regimes of culvert and watercourse maintenance are also described in Part 10 of ES Appendix 14.6: Flood Risk Assessment [**APP-477**]. Access and maintenance of ordinary watercourses during the operational phase, is secured through the draft DCO [**REP3-077**] under Schedule 14 Part 3. This includes protective provisions for drainage authorities, including provision for enabling access for the maintenance of watercourses.
ExQ1_Q10.4.6	N/A	**Construction phase drainage plan** It is noted that the Contractor is expected to develop a construction phase drainage plan to demonstrate how surface water runoff is to be managed both across the worksite and offsite. Given the programmed construction phase and the delays in commencing on site, should the temporary works design be undertaken to include climate change allowances up to 2030 or should they use the 'up to date' allowances over the construction period?
		Response: The requirement for the Contractor to develop a construction phase drainage plan is secured by commitment RDWE006 within Environmental Statement (ES) Appendix 2.2: Code of Construction Practice [**REP3-104**]. This commitment states that the design for temporary drainage works shall include climate change allowances up to 2030 in accordance with Flood risk assessments: climate change allowances[4]. Given the delay to the construction programme it is expected that the appointed Contractor would develop the surface water drainage design for temporary works to include climate change allowances up to the opening year

[4] Environment Agency (2022). Flood risk assessments: climate change allowances. https://www.gov.uk/guidance/flood-risk-assessments-climate-change-allowances

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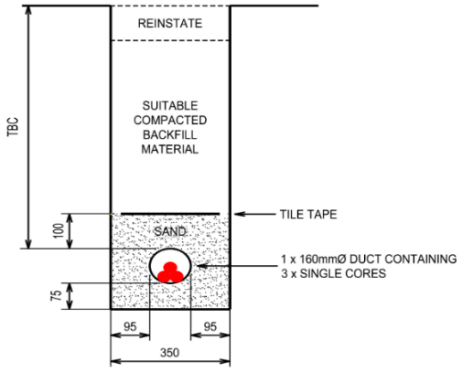
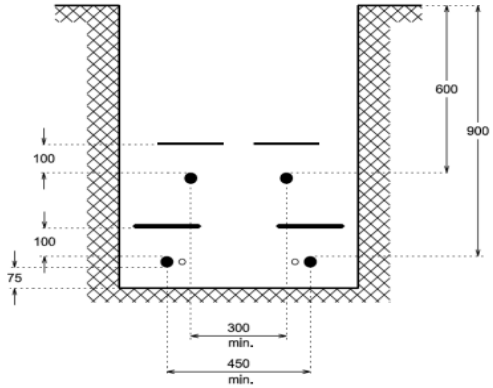
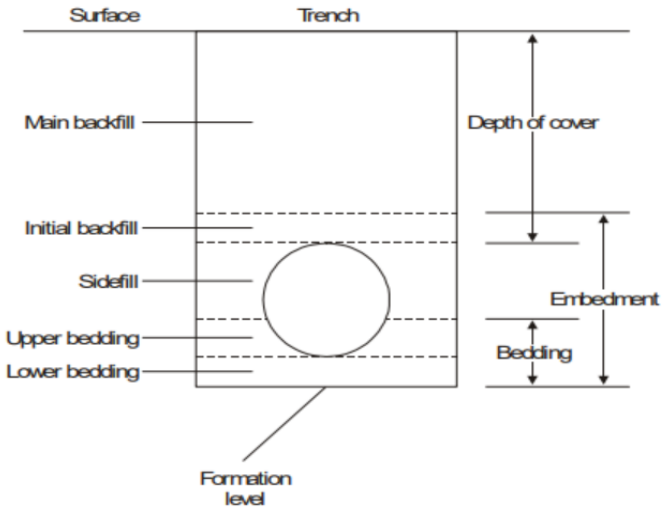
		in accordance with Flood risk assessments: climate change allowances. Commitment RDWE006 is being updated to reflect this in the submission at Deadline 4 [**Document Reference 6.3 ES Appendix 2.2 (4)**].
ExQ1_Q10.5.1	Environment Agency	**Mardyke** In ES Chapter 14 [APP-152], it is suggested in paragraph 14.5.15 that: "k. A raised bund would be constructed to prevent formation of the new flow path from Golden Bridge Sewer to the Mardyke in Orsett Fen. The bund would be designed to provide the intended function during storm events up to the 1 in 1000-year with climate change allowance to 2130 and incorporate a freeboard allowance of 60mm." - 60 mm of freeboard seems small (just over 2 inches). What is the justification for the small freeboard allowance? What effect would a 'more normal' 300mm freeboard allowance have on the proposals? - Has the bund been considered as being subject to the requirements of the Reservoirs Act 1975? What effect would this designation have on the proposals?
		Response: The Applicant confirms that the quoted 60mm of freeboard is a typographical error. The freeboard allowance included for in the design is 600mm. This is confirmed by the Project commitment RDWE039 secured through its inclusion in the Register of Environmental Actions and Commitments, within Environmental Statement Appendix 2.2: Code of Construction Practice, First Iteration of Environmental Management Plan [**REP3-104**]. The erratum has been corrected in the ES Addendum to be submitted at Deadline 4. The bund has not been considered in terms of the requirements of the Reservoirs Act 1975 because it is incapable of retaining water and would therefore not meet the qualifying volume of water (10,000 cubic metres).
ExQ1_Q10.5.2	N/A	**Low Street Irrigation Reservoir** Also in ES Chapter 14 [APP-152], it is suggested in paragraph 14.5.15 that: "o. The Low Street irrigation reservoir (located at Easting 567,023 and Northing 177,780) is groundwater fed. Utility corridors are proposed to the east, west and north of the reservoir (Work No. MU28 and Work No. MU33) and have the potential to form a barrier to groundwater flow, cause draining of groundwater that would otherwise flow towards the unlined reservoir or cause direct drainage from the reservoir. The spatial arrangement of the utility corridors and the below-ground materials shall be designed to prevent drainage from the reservoir, or barrier effects reducing groundwater flow to the reservoir (RDWE054)." Could the Applicant provide possible solutions at this stage to show that this can be delivered and are there any solutions that cannot be accommodated within the current Rochdale Envelope?

PINS ID	External Stakeholder (where applicable)	Question / Response
		Response: Typical open cut trench material configuration and materials are shown in ES Appendix 14.5: Hydrogeological Risk Assessment, Annex Q [**APP-459**], including Table 1.2 of the same annex. Given the typically shallow depths, shown in Table 1.1 of Annex Q, potential draining and barrier effects are likely to be small or absent. However, following a precautionary approach, commitment RDWE054 in ES Appendix 2.2: Code of Construction Practice (CoCP) [**REP3-104**] commits the Project to require the Contractors to consider reducing potential draining effects or barrier effects caused by utility corridors near the reservoir when designing the listed utility corridors. This would be done within the limits of deviation allowed for within the application. Further detail is presented below. The Contractors will develop the design for the installation of utilities around the reservoir and look to prevent adverse impact to groundwater flow to and from the reservoir. Standard methods of construction that would achieve this are as follows: For Work No MU28 and Work No MU33: a. The standard approach for the installation of these assets would be to install a ducted system via an open cut trench; the trench size and duct formation would be developed to fit the site constraints, but the general arrangement of the trench would be similar to those depicted in the cross section below. **Plate 2.2 Typical electricity network trench for a single duct** 

PINS ID	External Stakeholder (where applicable)	Question / Response
		Plate 2.3 Typical trench configuration for multiple electricity ducts or cables  b. The cable duct will be bedded, surrounded and backfilled with a granular material free of material that may damage the duct or cables to achieve a surround of between 75mm and 100mm. The rest of the trench shall be backfilled with excavated material that was removed until the underside of the topsoil, which would be reinstated. c. All 132kV and 33kV cables shall be surrounded with cement-bound sand, complying with the requirements of the Energy Networks Association Technical Specification 97-1 (ENA TS 97-01)[5] 'Special backfill material for cable installations', except where cable rating calculations prove that a stabilised backfill material is not required, to a compacted depth of 100mm above the cable. d. The type of materials used in the bedding, surround and backfilling will be selected to prevent adverse impact to groundwater flow to and from the reservoir.

[5] Energy Networks Association. (2016). Technical Specification 97-1 Issue 2 2016. https://www.ena-eng.org/ena-docs/D0C3XTRACT/ENA_TS_97-1_Extract_180902050427.pdf

PINS ID	External Stakeholder (where applicable)	Question / Response
		With regard to Work No MUT6: a. The pipeline will be installed and backfilled conforming to the Water UK Standards Board's Industry Guidance Note (IGN) 4-08-01 Bedding and sidefill materials for buried pipelines[6]. b. The pipeline will be installed as per the following typical trench configuration (Figure 1 of IGN 4-08-01). **Plate 2.4 Typical water pipeline trench installation**  c. Suitable bedding and side fill materials will be as per Table A.1 of IGN 4-08-01, which permits for a pipeline of over 300mm to 500mm a range of materials of 14mm to 20mm nominal single-size to fine sand, dependent on the ground type. d. The type of materials used in the bedding, surround and backfilling will be selected to prevent adverse impact to groundwater flow to and from the reservoir.

[6] Water UK Standards Board (1994). Industry Guidance Note 4-08-01 Bedding and sidefill materials for buried pipelines. https://standards-board.water.org.uk/document/ign-4-08-01-issue-4-bedding-and-sidefill-materials-for-buried-pipelines/

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		Other methods to consider at the detailed design stage include: a. Avoid disturbing the soil structure as much as reasonably practicable near the reservoir boundary. This will be achieved by affording separation between the trench and the reservoir utilising those provisions contained within the application. b. Use trenchless methods of installation, such as horizontal directional drilling if assessed to be appropriate. c. Clay stanks or other means shall be installed at intervals along the route of the trench to prevent significant alteration to the existing groundwater flow patterns. d. Install utilities at a depth that is below or above the water table, as necessary, if practicable. e. Consider the use of granular materials as trench backfill to allow the free flow of groundwater. In summary, all of the above methods can be accommodated within the current Rochdale Envelope. As there are sufficient methods which can be employed to avoid the creation of a barrier effect to groundwater flow within the limits of deviation, methods which would go outside the Rochdale Envelope have not been considered as they would not be permitted under the Development Consent Order.
ExQ1_Q10.5.3	N/A	**The Thames and Medway Canal** There is a proposed compound near the canal indicated on sheets 14 and 15 of the Works Plans [APP-019], which appears to have the potential of interfering with existing watercourse infrastructure. What mechanisms are proposed to minimise such interference? Additionally, it is suggested that use is to be made of the tow path as an access route. What is proposed to minimise damage to the tow path and likewise interference with the canal itself, (including the prevention of pollution etc)?
		Response: The question refers to the Milton Compound (Work no. CA3B as shown on Sheet 15 of the Temporary Works Plans [**AS-034**]), which is adjacent to the Thames and Medway Canal and within the Milton Police firing range. The Applicant has considered the potential for the Milton Compound (and its access route) to interfere with the existing watercourse. Resultantly, the Applicant has limited the works at the Milton Compound as communicated within the Environmental Statement (ES) Chapter 2: Project Description [**APP-140**]. The purpose of the Milton Compound is twofold: to construct a shaft for the reception and removal of the Ground Protection Tunnel's tunnel boring machine; and as a base for mitigation works to protect and remediate the Thames and Medway Canal and North Kent Railway assets from any tunnel-induced settlement. All works will be carried out according to the constraints and best practices detailed in the various submitted control documents, such as ES Appendix 2.2: Code of Construction Practice [**REP3-104**], including the Register

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		of Environmental Commitments (REAC), which ensure protection against pollution and impacts to watercourses. As the compound is partially situated within Flood Zones 2 and 3 the site would be laid out in accordance with a site-specific flood risk assessment (RDWE022). All assets will be subject to full pre-condition surveys and any physical works will be fully remediated and reinstated on completion as detailed in REAC commitment GS002 [**REP3-104**]. Regarding the use of the towpath as an access route, the Applicant confirms that the access route's use is limited to a low volume (carrying out activities as listed above only), and it will be subject to a full pre-condition survey; protection measures where necessary for Abnormal Indivisible Loads, such as trackway matting, verge reinforcement, speed limitation and canal bank monitoring; and then full repair/remediation, if required in accordance with REAC commitment GS002. To prevent offsite impacts associated with surface water runoff, the Contractor will develop a construction phase drainage plan, in accordance with commitment RDWE006 [**REP3-104**], which is to be secured via Requirement 8 of the Development Consent Order [**REP3-077**]. Wastewater generated from the compound welfare facilities would be discharged in accordance with commitment RDWE005.
ExQ1_Q10.5.4	N/A	**Watercourse Maintenance** There are a number of watercourses within and on the red line boundary. What allowances have been made to enable the maintenance of watercourses, especially on the red line boundary and particularly where the Applicant may not control the watercourse? What measures are proposed to reduce the risk of flooding to third parties, particularly those sites outside the red line boundary, during both the construction and operational phases? Within the design briefs for the various construction works, including habitat creation, what is the expected methodology in protecting existing watercourses and retaining an ability to undertake future maintenance? What changes are required in the submitted documentation to secure such?
		Response: Allowances have been secured within the application to enable the future maintenance of watercourses. Design Principle clause S12.05 [**REP3-110**] secures that where the Project crosses the statutory main rivers Mardyke, Orsett Fen Sewer and Golden Bridge Sewer, to facilitate access by the Environment Agency to these watercourses to undertake maintenance activities, a bankside access track shall be incorporated into the design of the crossings, the width of which would be subject to consultation with the Environment Agency. The draft Development Consent Order [**REP3-077**], under Schedule 14 Part 3, includes protective provisions for drainage authorities, including provision for enabling access for the maintenance of watercourses.

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		An outline construction phase risk assessment is presented in Section 16 of the Appendix 14.6: Flood Risk Assessment – Part 6 [**REP1-171**]. To reduce the risk of flooding to sites within and outside the Order Limits during construction, as secured by commitments RDWE001 and RDWE006 within the Code of Construction Practice (CoCP) [**REP3-104**], the appointed Contractors are required to prepare a construction phase flood risk assessment and construction phase drainage plan for approval by the Secretary of State following consultation with the relevant planning authorities. The construction phase flood risk assessment would consider all construction activities and temporary works necessary to deliver the Project and appraise on-site and off-site flood risk. The construction phase drainage plan will demonstrate how the Contractor would manage surface water runoff across the worksite, including details of how offsite impacts would be prevented. Appendix 14.6: Flood Risk Assessment – Part 6 [**REP1-171**] provides an overview of the flood risk management strategy to avoid the risk of flooding to third-party land during the operational phase for each of the flood risk assessment catchments (see Section 8 to Section 12). The design approach to flood alleviation for the Project is described in Section 6 and has been divided into mitigation measures, protection measures and resilience measures. The measures implemented by the Project are set out in Table 6.1. *Within the design briefs for the various construction works, including habitat creation, what is the expected methodology in protecting existing watercourses and retaining an ability to undertake future maintenance* During construction, measures to protect existing retained water courses and the species they support from runoff and discharge of pollutants, are secured in the CoCP [**REP3-104**] and via commitments GS005 and RDWE033. Where below-ground utility diversions are required, watercourses would be crossed using trenchless techniques and is secured via commitment RDWE008. Where temporary diversions are required or habitats are permanently and irreversibly lost, then habitat creation is proposed and secured via the Design Principles [**REP3-110**] clause nos. S9.10, S9.13, LSP.22, and the ES Figure 2.4: Environmental Masterplan Sections [**REP2-14**; **REP2-016**; **REP2-018**; **APP-162**; **REP2-020**; **REP2-022**; **REP2-024**; **REP2-026**; **REP2-028**; **and REP2-031**]. Where permanent culverting or replacement of existing culverts for watercourses is required, good practice culvert design is secured in the CoCP [**REP3-104**] via commitments RDWE013, RDWE030, RDWE031 and RDWE044 (as applicable). Vegetation reinstatement at culvert entrances would be secured via commitment RDWE009 and, where necessary, RDWE021. Monitoring and maintenance of project-installed culverts is secured via commitment RDWE014. With regard to project habitat and landscape creation areas, their maintenance will be in accordance with the requirements outlined in the Landscape and Ecology Management Plan (LEMP) [**REP3-106**]. This requirement

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		has been established through a requirement specified in Schedule 2 of the Development Consent Order (DCO) (Requirement 5) [REP3-077]. To access main rivers during operation, allowances have been secured within the application to enable the future maintenance of watercourses. Design Principle clause S12.05 [REP3-110] secures that where the Project crosses the statutory main rivers Mardyke, Orsett Fen Sewer and Golden Bridge Sewer to facilitate access by the Environment Agency to these watercourses to undertake maintenance activities, a bankside access track shall be incorporated into the design of the crossings, the width of which would be subject to consultation with the Environment Agency. In relation to the access and maintenance of ordinary watercourses during the operational phase, the draft DCO [REP3-077] under Schedule 14 Part 3, includes protective provisions for drainage authorities, including provision for enabling access for the maintenance of watercourses. *What changes are required in the submitted documentation to secure such?* The Applicant is confident that the control measures identified above are sufficient and adequately secured to protect existing watercourses during the construction phase.
ExQ1_Q10.6.1	N/A	**Water Discharge** In Chapter 14 [APP-152], it is suggested in paragraph 14.5.16 that there may be beneficial effects arising including "a. Discharge rates from existing retention ponds retained by the Project shall be reduced by at least 50% by providing additional storage volumes, benefiting the flood regime of receiving watercourses in the Mardyke and West Mardyke Tributary catchments (RDWE035)." Are there environmental or other consequences of this action and are these all considered in the submitted documentation?
		Response: Through item RDWE035 within the Register of Environmental Actions and Commitments (Section 7 of Environmental Statement Appendix 2.2: Code of Construction Practice [REP3-104]), the Project has made a commitment to reduce discharge rates by 50% on existing retention ponds. This has been subject to consultation with Essex County Council as the Lead Local Flood Authority for Thurrock Council and all drainage design related matters are noted as agreed, as per items 2.1.260 to 2.1.262 in the Statement of Common Ground between (1) National Highways and (2) Thurrock Council [APP-130]. The purpose of the retention basins is to reduce the effects of additional impermeable land cover on catchment rainfall runoff regimes, by providing storage and attenuating flows back towards greenfield (i.e. pre-development) runoff rates. The baseline low flow regimes of the receiving watercourses would not be changed and additional treatment of runoff would be provided, with benefits to receiving water quality. Therefore, there

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		would be no adverse environmental effects or other consequences of achieving this betterment in existing discharge rates.
ExQ1_Q10.6.2	Environment Agency	**Operational Surface Water Drainage Pollution Risk Assessment** In Appendix 14.3 – Operational Surface Water Drainage Pollution Risk Assessment [APP-456] the assessment concludes that the objectives of the Water Framework Directive would not be compromised by discharge of routine runoff from the Project. - As the project has to go through the Detailed Design phase, what measures are envisaged and can these be accommodated within the Rochdale Envelope? - How are the requirements to be secured to prevent the unintended dewatering of ecosystems during the construction phase? Additionally, are all expected outfalls shown in the approximate location? What level of confidence is there that no further outfalls will be required? Paragraph 4.4.3 states “The results confirm that following treatment, with one exception, cumulative discharges do not result in pollution of the receiving water environment” and describes the location and issue in paragraph 4.4.4. - Is this acceptable? - What amendments would be required to nullify the potential pollution?
		Response: *As the project has to go through the Detailed Design phase, what measures are envisaged and can these be accommodated within the Rochdale Envelope?* The Operational Surface Water Drainage Pollution Risk Assessment [**APP-456**] was undertaken using available flow and water quality data, applying conservative estimates where recorded data was lacking, to advocate the Rochdale approach, by assessing a worst-case scenario. Based on the treatment measures that are embedded within the design, for example, sustainable drainage features such as attenuation ponds with sediment forebays, the risk assessment has demonstrated that routine runoff from the Project, discharged from individual outfalls, would not cause pollution of receiving surface waters. The Project has committed, as detailed in RDWE025 within ES Appendix 2.2: Code of Construction Practice [**REP3-104**], to undertake further survey and sampling to define the flow regime and water quality of receiving watercourses at proposed points of highway drainage discharge. This data will inform the detailed design of treatment measures and will replace the conservative assumptions applied during the preliminary assessment. *How are the requirements to be secured to prevent the unintended dewatering of ecosystems during the construction phase?* Environmental Permits (as detailed in the Consents and Agreements Position Statement [**REP3-079**]) will be required for dewatering, discharges to surface or groundwater from construction. Compliance with the conditions set by these permits will prevent any unintended effects of the water balance of local ecosystems.

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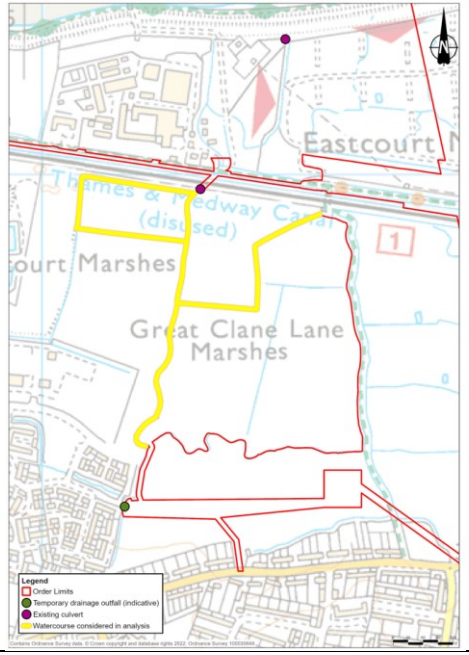
		Additionally, are all expected outfalls shown in the approximate location? What level of confidence is there that no further outfalls will be required? The locations of all expected drainage outfalls in their approximate locations are illustrated on the Drainage Plans [**REP3-065**, **APP-048** **and** **REP3-067**]. There is high confidence that no additional outfalls are expected to be required for the Project, however this is subject to confirmation during the detailed design of operational drainage networks. *Paragraph 4.4.3 states "The results confirm that following treatment, with one exception, cumulative discharges do not result in pollution of the receiving water environment" and describes the location and issue in paragraph 4.4.4. - Is this acceptable? - What amendments would be required to nullify the potential pollution?* As detailed in the Statement of Common Ground between the Applicant and the Environment Agency (item 2.1.53) [**REP1-058**] it is noted, as a matter agreed, that the Environment Agency has reviewed and approved Part 7 of the Flood Risk Assessment [**APP-466**], which describes the drainage design treatment measures and the efficiency of these measures based on (for surface water) ES Appendix 14.3: Operational Surface Water Drainage Pollution Risk Assessment [**APP-456**]. The exception reported on in paragraph 4.4.3 of the Risk Assessment is therefore considered acceptable. The exception to passing the cumulative pollution risk assessment is the combined discharge from outfalls S11-001 and S11-002, which are shown to affect a 900m reach of a tributary of the Mardyke. As evidenced by the sensitivity tests that have been conducted for this cumulative assessment (described in paragraph 4.4.5 of ES Appendix 14.3: Operational Surface Water Drainage Pollution Risk Assessment [**APP-456**]), minor amendments to the proposed discharge treatment measures would be necessary during detailed design to achieve an additional 5% treatment of solubles to avoid acute impacts linked to dissolved copper. This could be achieved by ensuring the required retention times and through-flow rates are met by the detailed design and this requirement is secured by RDWE025 within the Code of Construction Practice [**REP3-104**].
ExQ1_Q10.6.3	N/A	**Discharge to the River Thames** Paragraph 4.1.1 of Appendix 14.4 Hydromorphology Assessment [APP-457] suggests that there are no effects on any surface water features. However, during the construction phase, it is proposed to discharge treated rainfall runoff (southern entrance) to a ditch in Filborough Marshes. - Is the ditch designated as a "Main River" or an ordinary watercourse? - Who is drainage authority? - Is discharge ditch going to be tidelocked and if so, what are consequences? - Would it have the potential to affect any other watercourses in the catchment, and if so, have the effects been considered in the submission or have they been part of watercourses that have been

PINS ID	External Stakeholder (where applicable)	Question / Response
		excluded from the analysis? - If the tributaries have been excluded, what are the potential effects on the proposals if there are potential detrimental effects determined?
		Response: The ditch that is proposed to receive the discharge of treated rainfall runoff from the southern tunnel entrance compound (referred to in the Application as the western ditch) is designated as a main river and the Environment Agency is the drainage authority. The ditch has a reach length from the proposed discharge outfall location to the outfall to the River Thames of approximately 880m, and joins to a connecting network of ditches (illustrated in Plate 2.5), effects on all of which have been considered in the submission. **Plate 2.5 Ditches considered in the analysis of effects from the Project's proposed temporary outfall** 

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		The ditch network discharges via a flapped outfall into the River Thames, so is subject to tide locking. This has been considered in the design of the proposed runoff storage and treatment system. Calculations have been completed to quantify the effects of the additional volumes of discharge on water levels in the receiving western ditch and connecting ditches, including during tide locking when the ditch network stores water, at a typical depth (from observations) of approximately 1m. These calculations were shared with Natural England and the Environment Agency in agreeing the approach set out in the application. To reduce baseline water level change in the ditch network it is proposed to provide sufficient storage within the compound drainage treatment area to allow for discharges not to exceed the 1 in 1 year event runoff volume under tide locked conditions. This is secured by commitment RDWE033 within the Code of Construction Practice [**REP3-104**]. These calculations have been shared with the Environment Agency and, as detailed in the Statement of Common Ground between the Applicant and the Environment Agency (item 2.1.2) [**REP1-058**] it was agreed that an environmental permit would be obtained from the Environment Agency for the discharge. This has been secured by Project commitment RDWE033 'Discharge from construction of South Portal'. An agreement that there would be an application for an environmental permit was suggested by the Applicant to provide certainty of the protection of the water quality within the Filborough Marshes which form part of the Thames Estuary and Marshes SPA and is considered in detail within the Habitats Regulations Assessment Screening Report and Statement to Inform An Appropriate Assessment [**APP-487**].
ExQ1_Q10.6.4	N/A	**Discharge to the River Thames** Paragraph 4.1.4 of Appendix 14.4 Hydromorphology Assessment [APP-457] describes a new discharge pipeline to the River Thames, to provide "… a subtidal mid-water discharge for effective dilution and dispersal …", "… to maximise available dilution and mixing …". If the Thames is tidal, the discharge system will be required to act as a storage system until the water level reduces to a level that would allow a discharge to occur. During low levels in the Thames a method of stopping the discharge will need to be designed. - What type of mechanism is envisaged for this discharge system? - When it was not "high water conditions", what effect will the storage system have with the ground water system and where will the exceedance flows be stored? - What effect will there be when exceedance flows flow to a location that is not the River Thames?

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		Response: The pipeline and discharge referred to in Paragraph 4.1.4 of Environmental Statement Appendix 14.4: Hydromorphology Assessment [**APP-457**] would facilitate drainage of the northern tunnel entrance compound. It is proposed that a buried pipeline would be installed within a circa 300-400m long shallow sheet pile trench across the intertidal zone. The buried pipeline would terminate in a precast outfall or diffuser head on the subtidal riverbed slope, at or just below the mean low water line. The discharge waters would be pumped and due to this design, discharge to the wet channel of the River Thames would be possible under all phases of the tidal cycle, with no potential for 'backflow' when the outfall/diffuser is submerged. No storage system is necessary within the compound and therefore there would be no interaction with the groundwater system nor the potential for exceedance flows to be generated. The subtidal discharge is secured through Project commitment RDWE028 which also states that the discharge infrastructure would be designed in accordance with measures agreed with the Marine Management Organisation as detailed in the Deemed Marine Licence (DCO Schedule 15) [**REP3-077**]. Furthermore, commitment RDWE023 within ES Appendix 2.2: Code of Construction Practice [**REP3-104**] states that to mitigate potential effects on water quality and hydrodynamics within the River Thames, the discharge arrangement described in RDWE028 [**REP3-104**] would be constructed and operational in advance of the excavation of the North Portal and tunnelling works, and would be used for the discharge of treated construction phase effluents. All effluents would receive treatment prior to discharge into the River Thames to ensure compliance with the Environmental Permitting (England and Wales) Regulations 2016 (as detailed in the Consents and Agreements Position Statement [**REP3-079**]).
ExQ1_Q10.6.5	Environment Agency LLFAs Natural England Wildlife Trusts Environment Agency	**Mammal Ledges** The Applicant proposes to introduce mammal ledges in culverts on watercourses that suggest that watercourses may be used by commuting or foraging mammals. - Is it expected that the culvert should be designed to the full storm design parameters (including appropriate climate change additions) with the ledge remaining "dry"? - If not to what design storm should the culvert design reach? - What reduction in capacity is appropriate if the mammal ledge is submerged? - What changes to the submitted documents are required if the proposals do not assume the culverts are sized to meet the full design storm with the ledges remaining "dry". - What is the maximum length that it is considered that mammals will use such ledges? - What is the effect on the proposals if there are culverts longer than the longest appropriate length of culvert, or do not meet the suggested capacity for "dry" ledges, including what additional mitigation works are to be required? Do the Environmental Consultees have an opinion?

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		Response: *Is it expected that the culvert should be designed to the full storm design parameters (including appropriate climate change additions) with the ledge remaining "dry"? - If not to what design storm should the culvert design reach?* As detailed in Part 10 of the Flood Risk Assessment [**APP-477**], culverts have been sized such that mammal ledges would be set with a minimum 600mm headroom to the soffit of the culvert, and set at an appropriate level so that both the section in the culvert and the approach links remain dry and are easily accessible from the watercourse bank, in accordance with the recommendations of CIRIA (C786)[7]. As the CIRIA guidance does not specify what constitutes an appropriate level, for design purposes the ledges would be set 150mm above the 1 in 100 year storm event level with allowance for climate change. This is secured by commitment RDWE044 within the Code of Construction Practice, First iteration of Environmental Management Plan Annex C: Preliminary Works Environmental Management Plan [**REP1-158**]. Therefore, there would be no reduction in culvert flow capacity and no changes are required to the submitted documents. *What is the maximum length that it is considered that mammals will use such ledges?* The maximum length of effective mammal ledges is not known; however, studies have shown that underpass tunnels on National Highways schemes greater than 60m have been used by badgers, and that these longer tunnels are used at a higher rate than shorter underpass tunnels[8]. Although it is recognised that this study focuses on underpass tunnels rather than mammal ledges, the same principle for mammal ledges would apply. As such, it is considered that the length of mammal ledges proposed by the Applicant are appropriate and will be utilised by mammals. *What is the effect on the proposals if there are culverts longer than the longest appropriate length of culvert, or do not meet the suggested capacity for "dry" ledges, including what additional mitigation works are to be required?* There are no culverts that do not meet the suggested capacity for dry ledges, or that are longer than the known maximum length of underpasses/ledges that are used by mammals.

[7] Benn, J., Kitchen, A., Kirby, A., Fosbeary, C., Faulkner, D., Latham, D. and Hemsworth, M. (2019). CIRIA: Culvert, screen and outfall manual (C786).
[8] Eldridge, B. and Wynn, J. (2011). Use of badger tunnels by mammals on Highways Agency schemes in England. Conservation Evidence 8, pg. 53-57.

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